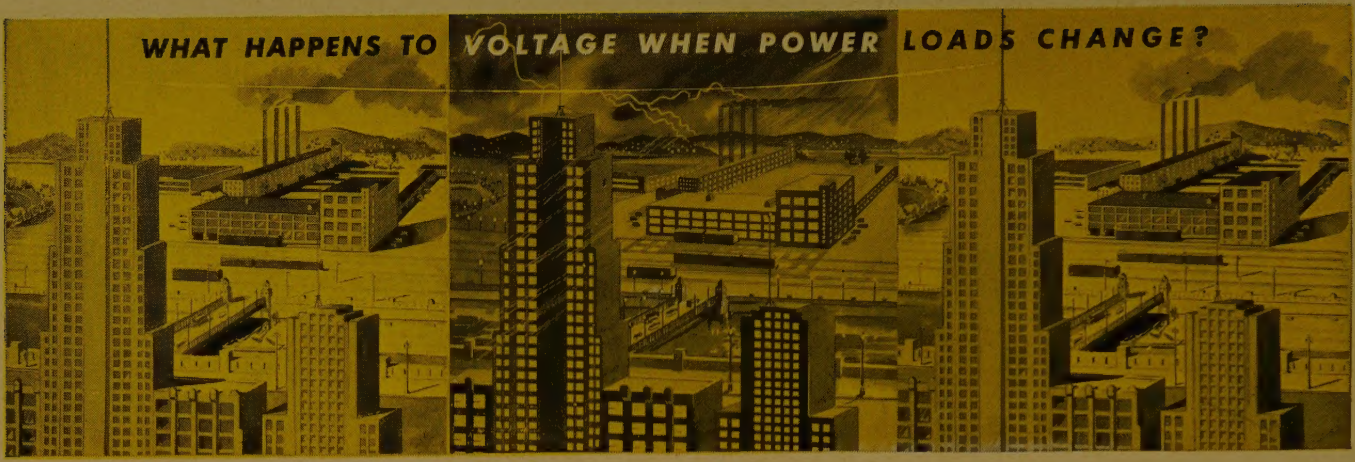
ELECTRICAL ENGINEERING

AUGUST–SEPTEMBER 1946

With this August–September issue, mailing dates of Electrical Engineering are advanced one month in order that the majority of readers may receive copies by the first of the month of issue. Details are given on page 408.

AIEE GREAT LAKES DISTRICT MEETING, INDIANAPOLIS, IND., OCTOBER 9-11, 1946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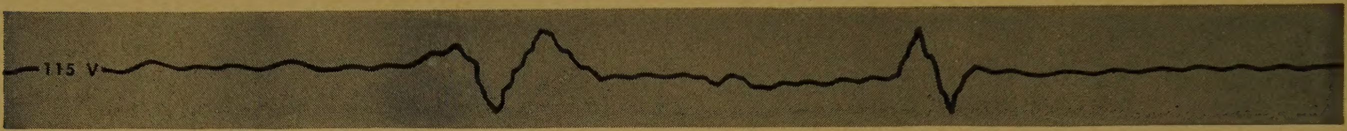
A SUDDEN INCREASE in power demands may cause a sharp drop in voltage until adjustments can be made at the source.

LESSENING DEMANDS may cause a sharp surge considerably above rated value before adjustments can be made.



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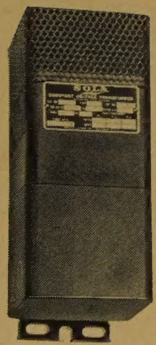

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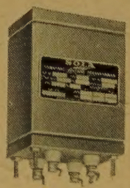

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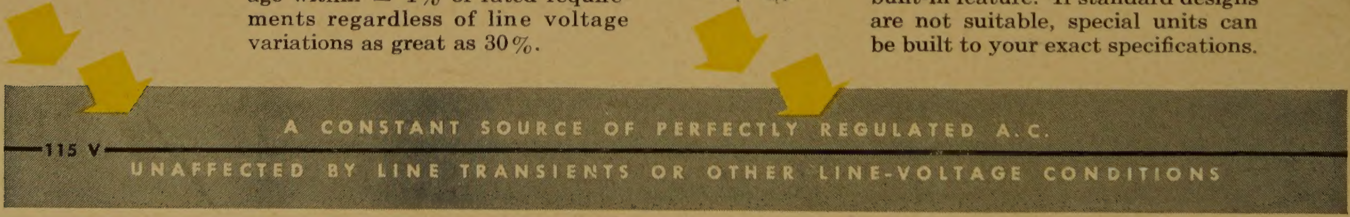

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Professional Goals for Today

WILLIAM E. WICKENDEN
PRESIDENT AIEE, 1945–46

Not until man learned to organize his efforts was he able to attain mastery over nature to any significant degree and so, as a result, most of his accomplishments have been confined to the past three centuries. With this example before him the engineer, also, has become interested in organization, but only in his particular specialized field. If engineers are to assume a role of leadership in the industrial world there must be a new unity among members of the profession as a whole, a unity which the Institute, as largest of the national engineering bodies, has a special obligation to cultivate.

WHAT WE CALL western civilization is a social order based on science and technology, the product of three centuries of the most highly organized effort of the human mind. Man has inhabited the earth for perhaps a million years, but within living memory he has gained in mastery over nature more than in all the millenniums which went before. Is the secret of this triumph some element of genius peculiar to the modern mind? It would be flattering to our pride to think so, but probably untrue. Geniuses of the first magnitude have been rare among the moderns. Who within these three centuries dares to measure his stature with a Moses, a Homer, an Alexander, a Plato, a Jesus, a Michelangelo, or a Shakespeare? The essence of modernity is that progress no longer waits on genius; instead we have learned to put our faith in the organized efforts of ordinary men.

Science is as old as the human race, but its effective organization is new. Ancient science, like placer mining, was largely a pursuit of solitary prospectors. Nuggets of truth were found, but often lost again, and the total wealth of knowledge increased slowly. Modern man began to transform his world when he began to mine the hidden veins of knowledge systematically. Science began to be powerful when it began to be cumulative, when observers began to preserve detailed records and to organize co-operating groups in order to pool their experiences and submit them to critical scrutiny. Effective science began when men made the winning of knowledge their distinctive function or profession, when specialists began to break it up into ever smaller fragments in order to pursue it more intensively. To this idea of progress that does not wait on some lucky break or rare stroke of genius, but instead is achieved through the cumulative, organized efforts of ordinary men, the engineer has contributed brilliantly. It is still his major responsibility.

Engineering and architecture stem from common origins, now lost in antiquity. Their separation into distinct professions, already well advanced in France and Holland, appeared in Great Britain as one of the later fruits of industrial revolution. It marked the transition from a highly individual art practiced by a few craftsmen, whose knowledge was largely the fruit of personal observation and experience, to a profession with advisory functions as well as individual skills, inspired by common ideals and regulated by the accumulated knowledge of many observers and practitioners.

FIRST ENGINEERING ORGANIZATION

The first impetus to organization sprang from an educational need. In a period when the British educational system ignored science and made no provision for technical and professional training, and when no established body of practitioners existed to afford an orderly apprenticeship, it was a formidable matter to enter upon an engineering career. In the account of the founding of the Institution of Civil Engineers in London we read:

> "It was toward the end of the year 1817 that a few gentlemen, then beginning life, impressed by what they themselves felt were the difficulties young men had to contend with in gaining the knowledge requisite for the diversified practice of engineering, resolved to form themselves into a society."

The eight founders, who were principally builders of machinery, began their deliberations by discussing the familiar parallel motion of Bolton and Watt. Clearly, this group had no thought of differentiating a distinct branch of engineering concerned with permanent structures and public works when they chose the title "Civil Engineers." The special significance we now associate with that title appears to have grown up around certain personalities and their professional interests, especially Thomas Telford, who became, by invitation, the first president of the new Institution and strongly influenced its character. Telford had been a stone mason, and his personal fame rested on great works of construction.

Telford at once recognized the distinction between the learned academies which had been instituted by the

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Essential substance of the presidential address delivered at the AIEE summer convention, Detroit, Mich., June 24–28, 1946.

governments in continental Europe and this more individualistic expression of British ideals. He reminded his fellow members that the very existence and standing of the Institution must depend on their conduct and exertions, that "talents and respectability are preferable to numbers and that from too easy and promiscuous admission, unavoidable and not infrequently incurable inconveniences perplex most societies." The functions of a selective professional guild, thus voluntarily assumed, were confirmed by royal charter in 1829 and always have been prized jealously among British engineers.

The famous definition of civil engineering as the "art of directing the great sources of power in nature for the use and convenience of man" framed by Thomas Tredgold as the basis of this royal charter, pointed to a unified rather than a differentiated profession. Strong forces of individualism, however, continued at work and prompted the establishment of the Institution of Mechanical Engineers as a separate body. By 1847, the dominant interest of the Institution of Civil Engineers in fixed construction had grown more pronounced. George Stevenson, self-taught genius and father of the locomotive, found the atmosphere of the older society uncongenial and himself possibly unwelcome, so lent his influence to the formation of a new society, of which he became the first president with his son Robert succeeding him. Apparently there was less caste feeling and more zeal for innovation in this new body, which stated as its objects,

> "To promote the science and practice of Mechanical Engineering and all branches of mechanical construction and to give an impulse to inventions likely to be useful to members of the Institution and to the community at large, and also to enable mechanical engineers to meet and to correspond and to facilitate the interchange of ideas respecting improvements in various branches of mechanical science and the publication and communication of information on such subjects."

By 1871, when the Society of Telegraph Engineers, later to become the Institution of Electrical Engineers, was organized, the eight notable founders, headed by Lord Kelvin, doubtless considered the creation of a separate and specialized institution as natural and inevitable.

So much for British example and influence transmitted to America. To the highly individualistic traditions of the industrial revolution there were now added equally individualistic influences of a frontier economy. Scattered personnel made the initial organization of the profession in America difficult. The first attempt in 1839 failed, and when the American Society of Civil Engineers and Architects finally was established in 1852 its activities were short lived, lapsing from 1855 to 1867, when the society was revived and reorganized as the American Society of Civil Engineers. While apparently planned as a national and inclusive professional body, the functions now distinctive to civil engineering were emphasized strongly in its early leadership and activities. The mineral and machine industries, which expanded greatly under the impetus of the Civil War appear to have had little place in its interests.

EDUCATION AS AN IMPETUS

At this time a new impetus toward specialization entered into professional life, through the establishment of a school of mines at Columbia University in 1864 and the introduction of a curriculum in mechanical engineering at the Massachusetts Institute of Technology in 1865. To these pioneer efforts the Morrill Act to aid the establishment of colleges of the mechanic arts soon gave an added impetus. Professors, whose interests tended to be individualistic, and the whole scheme of higher learning based on intense specialization borrowed from Germany, soon began to have a pronounced influence on the budding life of the profession. These forces can be traced in the organization of the American Institute of Mining Engineers in 1871, and especially in the American Society of Mechanical Engineers in 1880. In the latter, such men as Professors John Sweet and R. H. Thurston found an outlet for talents which might not have been afforded by a long established organization. The American Institute of Electrical Engineers derived much of its organizing impetus from the telegraph industry and throughout its 62 years has had much more intimate association with corporate industry than with independent practice.

Until fairly recent years almost every force of tradition and circumstance has worked toward a progressive fragmentation of the larger profession. The goals of organized effort have been chiefly the increase and diffusion of knowledge, the exchange of experience, the codification of practice, and the standardization of usage, and to all of these specialization has lent a powerful aid. It was usually easier for some dominant personality to gather a coterie of enthusiasts about some new specialty than to penetrate the barriers of inertia or vested interest in organizations long established. Loss of solidarity was seemingly a secondary concern; the profession-at-large was conscious of a common heritage of scientific knowledge and proud of its progress in practical skills. Not much else united it or seemed to matter.

The current Directory of Scientific and Technical Societies published by the National Research Council lists 1,259 such organizations in the United States and 143 in Canada. Included in the 1,259 total are 49 local, 40 regional, and 29 national engineering organizations, without national integration and with no end of proliferation in sight. Since the turn of the century, however, a slowly increasing trend toward unification has been apparent. Symptoms of unrest appeared as engineers came to realize that older and more closely integrated professions somewhat overshadowed them in prestige, that their own specialized forms of organization afforded little protection to their legal and economic status, that their influence on public policies and measures was small in proportion to their numbers and functions, that the revolutionary consequences of their activities carried with them a corresponding obligation to direct them to socially desirable ends, and that both the economic and military security of the nation rested largely upon their shoulders. Few of these concerns had been in the minds of the founding fathers or had found expression in stated aims of existing societies.

Among our leaders were a few men of vision like Charles F. Scott, who saw that existing organizations must come to know each other better and to work together more intimately if any foundation for future unity ever was to be laid. His influence on Andrew Carnegie, which bore fruit in the establishment of the United Engineering Societies and the erection of a common home for the four Founder Societies, must be ranked as a major act of statesmanship. Protest as well as vision was working toward unity. The American Association of Engineers, organized in 1915 with the avowed aim of complete solidarity in matters of status, welfare, compensation standards, and public influence, was, in fact, largely a protest movement on the part of the forgotten men of the profession.

Vision predominated in the establishment of the Federated American Engineering Societies (later the American Engineering Council) in 1920 as the ambitious effort of 36 engineering societies—national, regional, and local—to establish an "embassy of the profession in Washington." Stratospheric in conception and aims, it lacked a supporting base at the grass roots, and ultimately collapsed, just when it was needed most, as the constituent bodies withdrew their financial support.

Meanwhile a movement for professional licensure had been gathering momentum in engineering circles. The guild ideal of professional status maintained through self-established bodies of selective membership failed to satisfy a substantial and increasingly vocal segment of the profession who viewed with some envy the more exclusive status of physicians and lawyers. Doctors long had been licensed by the state as a matter of public protection and lawyers by reason of their public function as officers of the courts. The movement for licensure among engineers, it seems fair to state, while advanced as a measure of public protection, has been pressed primarily as a means of creating and defending a more distinct status for engineers. It is not an isolated movement, but has its counterpart among other groups seeking a similar goal, such as social workers, chemists, and physicists. The establishment of national, state, and local organizations to foster the licensing movement and to police its operations has been a natural and possibly an inevitable concomitant, and now is developing into a positive force for professional unification. The time is not yet at hand for a full appraisal of this movement. The results so far, while almost wholly good, are partial at best and remain far short of the goals announced. Many minor and some major abuses have been eliminated, but positive advances are discerned less easily. The possibilities for a gradual raising of educational and experience qualifications, and for unification on the level of personal status and public responsibility, seem definitely promising.

In the same period functional activities among engineers also have been working toward unity. The engineering educators, who individually have done much to foster specialized societies, at the same time have built up a powerful force for unification through their own national organization, recently reorganized and renamed as the American Society for Engineering Education. Engineers' Council for Professional Development, while yet to gain full momentum, has given an impressive demonstration of its possibilities in the accreditation of college curricula and in correlating them with licensure practices; also impressive is its contribution to a more reliable means of preselection for engineering students. The standardization movement, taking shape in the American Standards Association, has become a unifying force working across the boundaries of specialized fields and organizations.

More recently there has been a rapid multiplication at the roots of engineers' joint councils, creating the basis of local collaboration as a support for nation-wide collaboration which American Engineering Council lacked. Most recently of all, the Engineers' Joint Council, which has evolved during the past year from an informal conference committee of society executives, has become a potent agency for collaboration among five of our major national societies, and is extending its range of collaboration among other organizations on a task basis. While consciously avoiding any attempt to pre-empt any permanent role for itself, it actively is seeking to stimulate and guide evolution toward unity of effort in public and professional affairs on a high plane commanding the adherence and support of the recognized leaders of the engineering fraternity.

NECESSITY FOR UNITY

As these movements have advanced the cause of unity within the profession, powerful political, economic, and social forces over the continent have worked to make greater unity imperative. One by one the old landmarks of society have been going down, as economic pressure groups have been setting up new ones for their special advantage. Public policy no longer is made by a counting of individual ballots. Dominant groups in manufacturing, transportation, mineral industry, agriculture, and labor are organized solidly and have learned thoroughly the strategy of concentrating their shock troops on the political front. The traditional specialism and individualism of engineering and science are at home ill in this new political–economic world. A new political philosophy has become ascendant, in which agriculture is the protected ward of the state, labor can do no wrong, industry can do no right, and the professional and intellectual classes are too few and too scattered to count.

The hitherto highly individualistic professions now find themselves threatened on two fronts with loss of identity, as industry on the one hand tends to absorb them into an undifferentiated mass of salaried employees, and as organized labor on the other seeks to force them into regimented ranks of dues-paying card-carrying closed-shop bargaining units, while doing its utmost to destroy all salary differentials between technically skilled groups and those employing routine manual skills.

Engineers need to fortify themselves beyond all doubt, but I must confess to being concerned less about protective measures than constructive ones which may enable engineers to seize their now unprecedented opportunities for leadership in the industrial world. It is the business of the scientist to wrest secrets from nature and that of the engineer to make them useful to man. These roles continue in war and in peace; they do not change with circumstances. They grow in importance as the world's population multiplies (it has doubled in the last century), as the standard of living rises (income standards have risen six-fold since colonial days), as the need for new wealth increases, and as the original stores of natural wealth—what we may call wind-fall wealth—decrease. Civilization is simply a race between progressive exhaustion of nature's treasures and the ability of science and technology to renew and replace them. So far we have been winning the race by drawing upon new deposits, but it must be apparent to all that the period of wind-fall wealth in America daily is drawing nearer its close. This fact invests the dawning era of nuclear energy with special significance. For older and spent countries like Britain its potentialities for good or evil are startling.

But there is yet another role for scientist and engineer, less dramatic but equally critical. It consists in bringing the spirit and service of professional life more fully into the direction of industry. Obviously, some new directing force is needed. The old rule of power, vested in ownership, has broken down. Management's past excesses and blunders arise at every turn to plague it, most of all in the incitement given to labor to demand power without responsibility. The rule of bargaining has broken down, only its legal shadow remains as government intervenes to fix wages and dictate price levels. The rule of political appeasement has broken down, with the pay-off of wartime promises that labor's part was to be all gain and no sacrifice. The rule of labor solidarity has broken down as the nation revolted on the brink of paralysis. And now public authority has broken down, as the President, on the threshold of chaos, began by shaking his fist and ended by shaking his finger.

The doctrine of sacred rights has broken down, the right to do whatever one chooses with one's property, the right to run one's business as one pleases, the right to hire and fire at will, the right to work at will, the right to strike on caprice, and the right to imperil the community and nation to get one's way. The word *sacred*, it appears, has been a shield too lightly seized. Wise old Justice Holmes, in a day when the Supreme Bench commanded higher honor, spoke the brave and simple truth,

> "When the power of either labor or capital is exerted in such a way as to attack the life of the community, those who seek their private ends at such costs are public enemies."

Implicit in the breakdowns recited is the simple truth that there are not two parties to the struggle but four. *Investors* have a stake in it. Industry without capital is inconceivable; men will not save without incentive or risk without hope of gain; and no free government ever has existed apart from free enterprise. Invested wealth cannot strike and survive nor can it walk out on its job at will. Its only worth, except as junk, is in its productivity and there hangs over it at all times, like threat of doom, the spectre of obsolescence. These things should be the measure of its reward, but property rights are relative and not sacred.

Workers, too, have their stake. Men must work not only to live but to maintain their sense of worth. Slaves can be driven by the lash, but free men will not put their hearts into their work when driven by compulsion, haunted by fear, denied the right of association, or frustrated from normal self-expression. What fallacy was discredited more than the supposed economy of low wages or excessive hours of work? Men are entitled to the conditions and rewards of work that will make them most efficient, but this right is relative and not sacred.

Consumers, too, have their stake. Subsistence is possible on a hill-billy farm, but no one can prosper unless customers can buy. Artificial scarcity and inflated prices can bring only transient gains to the few, while abundance at attractive costs benefit every one. Henry Ford's high stroke of genius was in curing the automobile industry of its luxury complex at an early age and at a high wage level. It is not in the general interest that labor alone should receive the entire fruit of scientific advance and technological gain, as it is now demanding, in the face of its own decreased productivity. High wages with high production make eager customers, and the battle against inflation actually is not fought in Washington but upon industry's production lines.

The *public* too has its stake. An unstable economy is a threat of public calamity. Nine-tenths of the world's business is done on credit, and credit is faith in a future where a dollar will be worth at least as much as it is today. If we in the United States have inflation, inevitably we shall lend-lease it to our neighbors, and possibly to the world. If we create an artificially high wage level or scant production we may force our economy back within itself and so dim the hope of recovery for other peoples and make the peace of the world just that much harder to maintain.

The nation at this juncture is sorely in need of leaders who can see its economy and its international interests whole, and not as partisans of labor, or ownership, or agriculture, or geographical units, or political blocs. Industry, likewise, is sorely in need of leaders who can bring reconciliation from within. I believe the hope of finding such leadership lies in the essential quality of trusteeship which is embodied in professional life and service. Among the professions, I believe engineering has a unique contribution to make. Only as we entrust leadership in industry more fully to professional men who acknowledge their responsibility to investors, workers, customers, and the public alike, and whose highest aim is to reconcile and unify these interests for the common good, can there be hope of finding some way out of this crippling strife. If the engineer meets this challenge, he will be the man of destiny.

ADVANTAGES OF THE ENGINEER

The engineer faces this challenge with marked advantages over any possible rivals. He is there on the ground. He already has driven a deep salient of professional interest and spirit into the industrial world. In the electrical, chemical, metallurgical, and automotive world he is already dominant in management. His methods—factual, objective, analytical, experimental, and inventive—are in his favor. His position is a natural bridge between the mechanical and the commercial skills. He starts from an impartial base, with professional canons of integrity, trusteeship, and ethical obligation that rise above the lowlands of partisan expediency. He does not start singlehanded, but has behind him a great organized body to reinforce his standards and ideals.

The essential conflict between labor and industry today is not merely a struggle for rewards, but also a struggle for security. Our fathers found their security in the soil, in years of adversity they returned to the land. Now, when lean years come, the urban and industrialized population has no place to go except to the relief rolls and the insurance office. Our fathers were a land- and property-minded generation; we are a job- and social-security-minded generation. There are tides in the affairs of men, as inevitable as the tides of the sea. Engineers control the tides and prevent them from washing away the shore line; they even harness them and turn them to useful work: but only fools try to sweep them back with a broom.

In today's epic conflict between labor and industry, the engineer has a five-fold part to play. *First*, he must speed the advance of research and the improvement of machines and processes which alone will enable industry to meet its newly imposed obligations to labor, and still earn the profit necessary for its survival. *Second*, he must persuade labor to put its heart back into production. To this end he must devise incentive methods of compensation, set fair standards of output, and convince labor that these incentives, standards, and rules of reckoning are on the level and will work to the general interest. *Third*, he must convince labor that its own interest is served best by keeping the engineer on a professional level, where he can act impartially and independently, rather than by forcing him into the rank and file of union organization. *Fourth*, he must convince the employing world that he is not just a nondescript employee to be ordered around at will and paid the least the traffic will bear, but is actually a professional man exercising high knowledge and skill, under compact with his colleagues to observe an austere ethical code and a high role of trusteeship. *Fifth*, he must strengthen and implement his professional life by organization so that he can act with independence and impartiality and that his voice can be heard effectively on public issues which affect vitally the security and economic welfare of the nation.

The historic diversity of engineering organizations has been exceedingly fruitful. It has contributed magnificently to the gain and diffusion of knowledge, to the interchange of experience, to the testing and codification of practice, and to the standardization of usage. It has encouraged originality and innovation. It has given vigorous new blood a chance at leadership. It has prevented the ossification of vested interests. The Institute, and its sister organizations, are tested tools of progress to be kept tempered and keen. Under no circumstances should they be blunted or discarded in the interest of a merely formal unity. Nevertheless, unity is needed on a level above specialization, to provide the safeguards of professional independence and the instruments of public influence without which the engineer cannot fulfill his role of trusteeship in modern industrial society.

Professional life is one of the few areas of experience where there is a whole which is more than the sum of the individual parts. Each has his daily work to do, but there is a total job for engineers to do collectively beyond the total to which the daily tasks add up. The parts have flourished magnificently, but the whole is yet to be created. No one possesses a blueprint of it. When it comes it will be a product of evolution rather than design. Search for it must engage our best minds and be a goal for our strongest organizations. This is not a role for minor prophets. Before there can be national unity on the plane above specialization, there must be local unity. That is the way of democracy. The thing to be done is to plant the seeds of such unity, to cultivate and fertilize them, in order to encourage and speed the course of evolution and to guide it toward high and not petty ends. The Institute, as the largest of our national engineering bodies, and the only one with a solid tri-national basis, has a special obligation to foster this effort, while assiduously cultivating its own distinctive field. This has been the goal to which your officers and directors have dedicated their unstinted effort during the past year.

Short Survey of Japanese Radar—I

ROGER I. WILKINSON
ASSOCIATE AIEE

The result of a study made immediately following the fall of Japan and recently made available for public information, this 2-part report is designed to present a quick over-all evaluation of Japanese radar, its history and development. As the Japanese army and navy developed their radar equipment independently of each other, Part I of this article concentrates on the army's contributions.

RADAR IN JAPAN dates back to 1936 when credit is given to Professor K. Okabe of the University of Osaka for devising an electronic method for detecting the presence of passing aircraft.* At this time Professor Okabe was working under the famous Doctor Yagi, dean of science at the university. In his method, a radio transmitting station sends a continuous radio frequency signal, with superposed audiomodulation in as narrow a beam as convenient, to a distant receiving station. If an object such as an airplane enters the transmission path, the normal uniform signal or tone heard at the receiving station is disturbed and, instead of being steady, comes in with a strong beat note. This is an application of the well-known optical Doppler effect.

The Japanese classify their radar sets under two generic headings:

Type *A*—Continuous wave or Doppler systems.
Type *B*—Impulse systems.

According to Professor Yagi, the idea for type-*A* radar equipment arose following a trip he made to Germany before the first World War during which he became greatly interested in supersonic signaling. Upon his return he performed a number of experiments in this science which led him and Professor Okabe to study the effects of the presence of foreign objects in radio fields. It was not until the middle 1930's, however, that Japanese military people became much interested in such detection problems. They then encouraged Professor Yagi and his associates to apply their knowledge to the advancement of war techniques. Professor Okabe was a leader in the electrical engineering school at Osaka and was given the assignment. He proceeded forthwith to run many laboratory and field experiments on Doppler detection for the army and navy. The method had the great advantage of requiring only very small amounts of power. It had the decided drawback, however, of not giving the definite location of the target along the line between the sending and the receiving stations. Professor Okabe and his assistants tried long and hard to solve this problem, but unsuccessfully. In 1938 a large power output set was required to be used; in 1939 a much smaller set was adequate (three watts) and was used experimentally and practically at Hankow. In 1940 various sets with powers from 3 to 400 watts were built. The first Doppler system for aircraft warning was set up in 1941.

It is claimed vehemently by the Japanese that their studies of Doppler detection were conceived quite independently of the suggestions made by Doctor C. W. Rice, of the General Electric Company, whose papers on the subject appeared in American journals in 1936. Be that as it may, all Japanese radar research and development engineers are familiar with Doctor Rice's writings.

It was not until 1940 that the idea of type-*B*, or pulsed, radar equipment arose strongly enough for researches on this technique to be initiated. Its advantages were manifested so quickly that the chief effort thereafter was devoted to developing this method.

Unlike American practice, both systems were installed side by side in the army early-warning nets surrounding Japan, and facilities were provided at the information centers for simultaneously displaying the information from both. The Japanese navy also developed a type-*A* system but never put it into actual operation.

Type-*A* radar equipments (or detectors, as all early-warning devices are called in Japan) operating in the 40–80-megacycle band were found to give indications of the passage of aircraft across a fixed line in mountainous places where pulsed types were unsuccessful. They were operable also over much greater distances. The longest type-*A* line of detection used was from Formosa to Shanghai, a distance of more than 400 miles.

In 1937 the navy research laboratory was experiment-

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* The term "radar" first appeared in Japanese papers near the end of 1944. The Japanese were under the impression that it was used in the United States only to describe the plan position indicator (PPI) search type of set found in B-29's. Instead of radar, the Japanese call early-warning sets detectors; searchlight and antiaircraft fire control sets are known as locators.

Based upon an official report, "A Short Survey of Japanese Radar," prepared by the Second and Third Operations Analysis Sections for Headquarters, United States Army Air Forces, from studies made by the Analysis Sections and the Air Technical Intelligence Group, Far East Air Forces, United States Army.

Roger I. Wilkinson was operations analyst for the 13th and Far East Air Forces from October 1943 to December 1945. His assignment after the fall of Japan was to study all phases of Japanese electronics and radar from research to operations. He now is back with Bell Telephone Laboratories, New York, N. Y.

Acknowledgment is made of the services of Robert P. Featherstone, formerly captain, Army of the United States, who assisted in the collection of information contained in this survey.

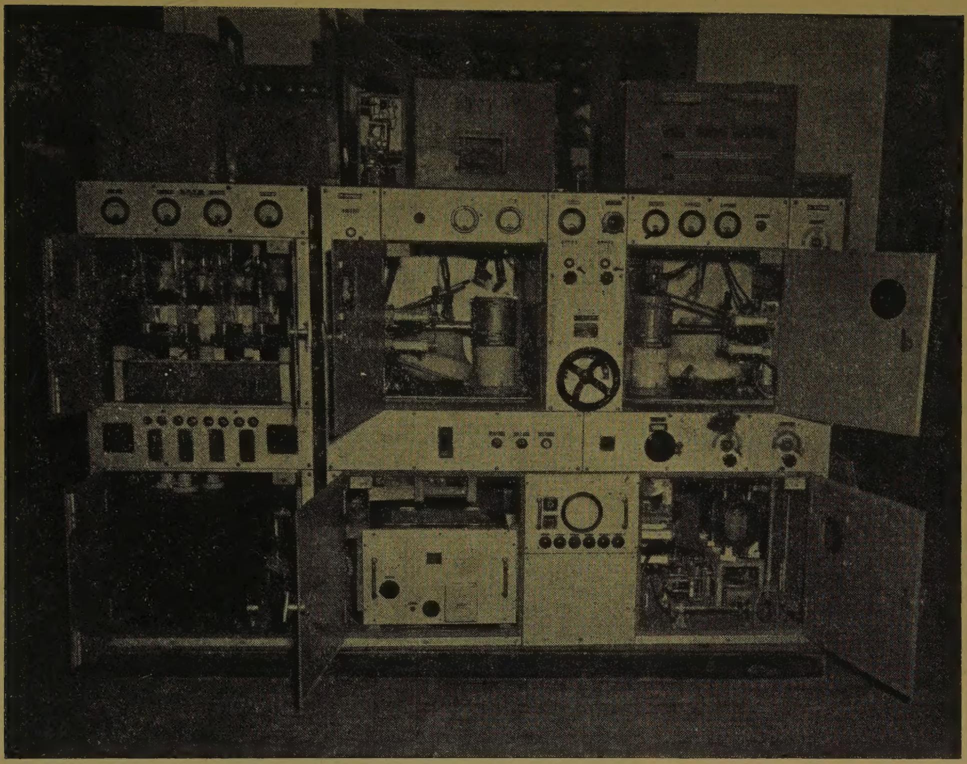

Figure 1. Interior view of transmitter and power units of Tachi-6 which corresponds somewhat to the American SCR-270

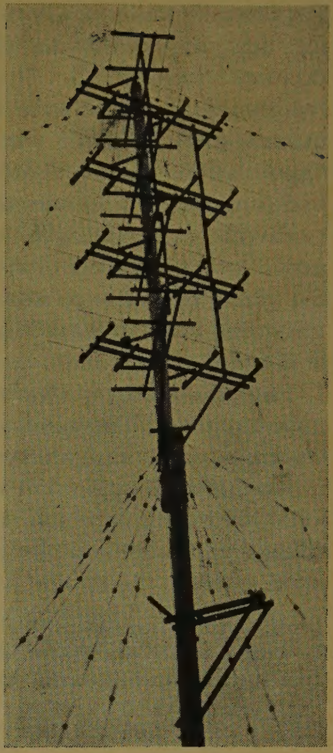

Figure 2. Tachi-6 transmitting antenna

ing with frequency-modulated continuous-wave radar, utilizing the same principle used in the present American and Japanese low altitude altimeters. In that year a large fleet parade was held in Tokyo Bay, and ranges were obtained up to five kilometers. This was considered unsatisfactory and the experiments were abandoned.

RADAR NOMENCLATURE

Before continuing with a discussion of later developments which will revolve about particular sets, it will be well to describe briefly the systems of radar nomenclature used by the Japanese army and navy. Japanese radar designations are about as confusing and difficult for the layman to remember as those used in the United States. Over a period of years, Allied radar intelligence people laboriously built up a background in Japanese navy sets, which, in general, were differentiated by four items:

1. Mark (Go).
2. Model (Kei or Gata).
3. Modification (Kai).
4. Type (Shiki).

Apparently this was too much for even the Japanese to keep straight, inasmuch as officers and men in their service usually referred to their equipment either by shortened numbers or by nicknames. For instance, the navy's 10-centimeter surface search sets mark 2 model 2 modifications 1 to 4 all were called simply number 22, while the night fighter's prototype 19 air mark 2 model 11 generally was called Gyoku-3.

The official designation system used by the Japanese Navy Technical Department was based on employing the following as the tens digit in the number assigned to any equipment:

1. Land-based search.
2. Ship-borne search.
3. Ship-borne fire control.
4. Antiaircraft fire control.
5. Panoramic indication.
6. Guiding type (ground controlled interception).

The second digit was supposed to be selected according to:

1. Fixed—for instance, number 61 was a fixed-type for guiding or ground controlled interception.
2. Mobile—for instance, number 12 was a land-based search set on a trailer.
3. Portable—for instance, number 13 was a lightweight land-based search set.

In the case of the 2-ship-borne series, however, the second digit refers to a wave length code and not to the degree of mobility. Japanese navy people readily admitted that this system of numbering was far from perfect.

Unofficially, the Japanese navy research laboratory gave each set a name or number as met their whim.

For instance, in the air-borne set FD-1, the "F" stands for "fly," or the German "flutzeig," and the "D" for decimeter wave length. Number 1 was the first one of the series built on the same fundamental designs. The unusual name Gyoku-3 arose from the Japanese word "gyoku-sai," meaning "all-suicide," which may have had considerable appropriateness, inasmuch as this was to have been a night fighter radar set. The letter "K" added to the numbers of certain sets does not refer to the year 1943, as once was suggested in American intelligence, but stands for "kantau" which means simple or simplified.

The Japanese army also had a fairly logical set designation system. The numbers were assigned during development and usually stayed with the set. The type number of each equipment was preceded by one of the following words, in which the prefix "Ta" comes from "Tama Institute" and the suffix from a characteristic word, giving:

Tachi, meaning land-based ("chi" from tsuchi meaning earth).
Tase, meaning ship-borne ("se" from misui meaning water).
Taki, meaning air-borne ("ki" from kuki meaning air).

ELECTRONICS RESEARCH

Electronics research was handled entirely separately by the Japanese army and navy. Much of the navy work was done by research laboratories directly under the navy ministries. The army, however, assigned more of its pure research to various universities and technical institutes. At the same time several of the larger radio and radar manufacturers were engaged actively in vacuum tube and materials researches, some by direction of the military people, and the rest through their own inspiration. Besides this, of course, the manufacturers were engaged with the problems, many of which bordered on pure research, of trying to meet the specifications for sets ordered by the two services. Incredible as it sounds, engineers and research men in electronics at the large manufacturing companies seldom were told how their equipment worked in the field; they were not allowed to go on shipboard to inspect an installation to say nothing of watching a radar set in operation. Likewise they were not permitted to visit ground radar installations in the field. Consequently, the men doing much of the designing of the equipment had very little means for observing and correcting their mistakes, an almost insurmountable obstacle in the road of rapid development.

Professor Yagi, well known for his antenna designs, was nominal head of civilian fundamental research. He was outspoken in his criticism of the manner in which the high commands had neglected electronics research on a broad front. In the early days of the war both army and navy officials could not be convinced of the tremendous value that radar might be to them in the defense of their islands. They thought in terms of being always on the offensive, while radar was considered primarily a defensive weapon. Thus they backed only a comparatively leisurely program of radar development. When the top Japanese militarists found they had guessed wrong it was too late to try to catch up with Allied developments.

There was a small number of very able and well trained scientists in Japan, principally in industry and in academic circles. It is of interest to note, however, that in no cases were projects of any great importance turned over to the universities to direct and carry through as they thought best. Usually, small studies, carefully circumscribed by military directives, were parceled out to an individual professor to work on. Often he had no idea of its ultimate use in the radar field. As a result, the utilization of civilian scientific talent, as contrasted with a nearly 100 per-cent mobilization in the United States and Great Britain, was very small and in this way the severe scarcity of first-rate electronics men in Japan was aggravated further by the military's unintelligent direction of their abilities. The meagerness of the program of fundamental electronics research is indicated by the fact that at the close of the war the army had only 39 projects assigned to 13 outside agencies other than the manufacturers.

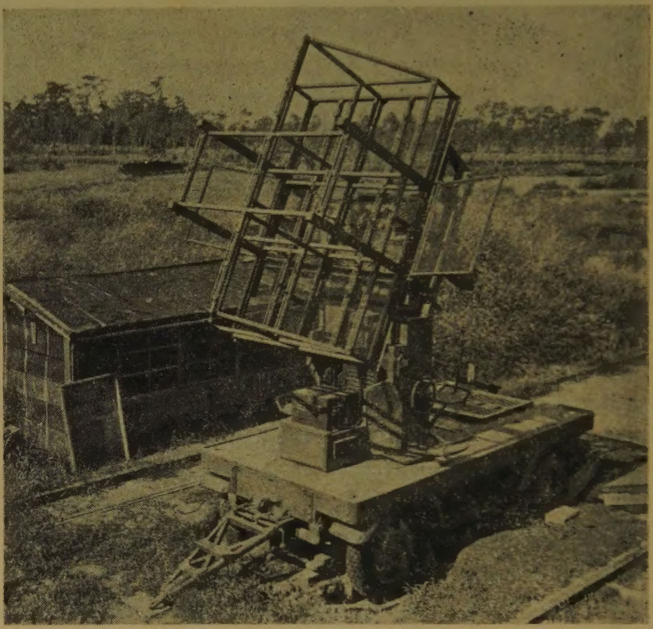

Figure 3. Tachi-2 with transmitting and receiving antennas mounted together on the same mobile trailer mount

DEVELOPMENT OF ARMY RADAR SETS

In 1940 a Japanese technical commission spent several months in Germany and returned with reports of pulsed radar equipment being built in England. This gave new impetus to farseeing officers in the Japanese army and navy to make further studies of its possibilities. Accordingly, the first researches in the army's search radar sets were initiated in 1941.

To co-ordinate the various projects which were beginning to spring up in the army's radar investigations, a research group, called the Tama Research Institute, was formed in 1943 under the leadership of Lieutenant General Suda. This institute was charged with responsibility for all radar research for the army. It also provided a consulting service for the army forces operating the equipment. For example, it assisted in selecting sites in difficult cases. When continuing trouble arose in certain sets, Tama attempted to find the answers.

The institute's laboratories, which were located in the western outskirts of Tokyo, were bombed heavily on April 3, 1945, and about 50 per cent destroyed. Various sections of the research work then were dispersed to other parts of Japan.

The staff of the institute comprised 88 officers and 96 trained assistants. There were an additional 600 persons on the payroll, of whom about half had some technical knowledge. The rest were stenographers, guards, and similar help.

The institute's appropriations for the past three years were:*

1943—12,000,000 yen

1944—16,000,000 yen

1945—16,000,000 yen (of which only about 7,500,000 yen were spent)

These figures included certain costs for models constructed, and of the remainder, 80 per cent was spent for experimental work and 20 per cent for fundamental research.

A summary of Japanese army radar equipment which had been developed or was under study at the end of the war is given in Table I. The information for this table, furnished by Tama Institute, omitted one notable equipment series known as Taki-24 and 34, microwave airborne extensions of Taki-14, with many features paralleling modern American search equipment. The development of this series was discovered only after considerable tracking down of rumors of its existence.

ARMY SEARCH RADAR SETS

As a general rule, Japanese search radar sets were designed for simplicity of operation and presentation. A single *A*-oscilloscope showing range was the usual case. Bearing was obtainable only roughly through guessing at what point the maximum signal was received. The height-finding radar sets, Tachi-20 and Tachi-35, had more elaborate displays. Resort to pip matching on an azimuth and elevation oscilloscope was the procedure in these cases.

The first army set to be built was the rough prototype of what is now known as Tachi-6. This is the large fixed installation used for primary early warning and corresponds somewhat to the American SCR-270. Frequencies assigned varied from 68 to 80 megacycles. It made use of one transmitter looking either in all directions or over a rather wide fixed arc, with a series of receivers, each looking over a much narrower but movable angle. The first Tachi-6's were produced in 1942 with powers ranging from a 10-kw to 50-kw peak. Figure 1 shows the transmitter and power unit of Tachi-6 while Figure 2 shows the antenna installation at Shimoda, one of the main warning locations, 150 kilometers southwest of Tokyo.

Portable sets were needed to supplement the ponderous Tachi-6 equipment, which was ill adapted for use outside of the home or mandated islands. Accordingly, the mobile Tachi-7, weighing 18 tons including vehicles and operating at 100 megacycles, was developed in the same year. It was ready for service in 1943, and most of the 60 sets manufactured were sent overseas, where mobility and ease of handling were of great importance.

A still lighter set was needed for portable service. For this, work on Tachi-18 was begun early in 1943, and a 100-megacycle set weighing only four tons was completed at the end of the year. These latter sets were retained mainly in Japan, where they provided a standby for Tachi-6 or assisted in reading through Allied jamming signals.

Tachi-6, like the American SCR-270, gave only the barest information on airplane heights. Tachi-20, with lobe switching in both azimuth and elevation, was installed at Choshi in March 1945, and Tachi-35, with goniometer pick-ups from pairs of azimuth and elevation antennas, was installed at Matsuda in May. These sets, working in the 80-megacycle range, were the army's attempt to answer the height problem. They were only partly successful.

In late 1942 the army began studies on a radar set to be installed on transports and other large ships for protection against Allied submarines. This led to the building of the 15.7-centimeter Tase-2 set by the Nihon Musen Company. In February 1943, installations were made on two ships, but the set did not have sufficient power to give satisfactory range, so it was earmarked for use on land. A second marine set, Tase-10, operating at 150 megacycles, was produced in December 1944. This set was designed expressly for use on transport submarines. However, upon its completion, Japan had left only one submarine of size suitable for its installation, and this installation proved abortive when the submarine's power supply was found to be inadequate.

The first army air-borne set, Taki-1, was built by the Nihon Musen Company in 1943, with only six months elapsing between drawing board and installation. Taki-1 operated at 200 megacycles with a 10-kw peak output, weighed 150 kilograms, and was for use on heavy bombers. Presentation was on a simple *A*-oscilloscope with a scale laid off by range marker pips. A certain amount of directional searching was obtainable by switching transmitter and receiver to any one of three antennas, a nose Yagi antenna, and a doublet on either side of the fuselage. This set was considered very satisfactory for sea search, giving ranges of 50 kilometers or more on large ships, and more than 1,000 sets were built. Smaller and lighter editions came out from time to time.

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* The current military rate of 15 yen to one dollar is likely to be rather misleading as to the magnitude of the budgetary figures. The average factory worker in Japan is paid from seven to ten yen for a 10-hour day, or, say, one yen per hour. For equivalent work, factory employees in the United States would be paid perhaps one dollar an hour. For a rough estimate of the equivalent American purchasing power allotment for these activities, the figures given might be considered dollars.

It was appreciated that greater definition in the oscilloscope presentation than that given by Taki-1 was desirable. Accordingly, in August 1943, research was started on a centimeter wave length air-borne radar called Taki-14. The first set, operating at 27 centimeters with a triode transmitting tube, was completed in August 1944 under the direction of Major Uozumi of Tama Research Institute. The antenna was a Yagi array with a paraboloid reflector. The set, when installed on a heavy bomber, gave maximum ranges of only 25–30 kilometers, which was thought not nearly good enough. By a series of experiments on the transmission lines and the antenna, the ranges were stepped up to 40–50 kilometers by February 1945. Production was made very difficult by the B-29 bombings of the plant doing the manufacturing, so that no sets actually were installed and in use by the end of the war in August. Continued experiments during this period involving the use of cavity tuning had brought the range up to 70–80 kilometers. The disposition of this latest experimental air-borne equipment is described poignantly by Major Uozumi, project engineer on Taki-14.

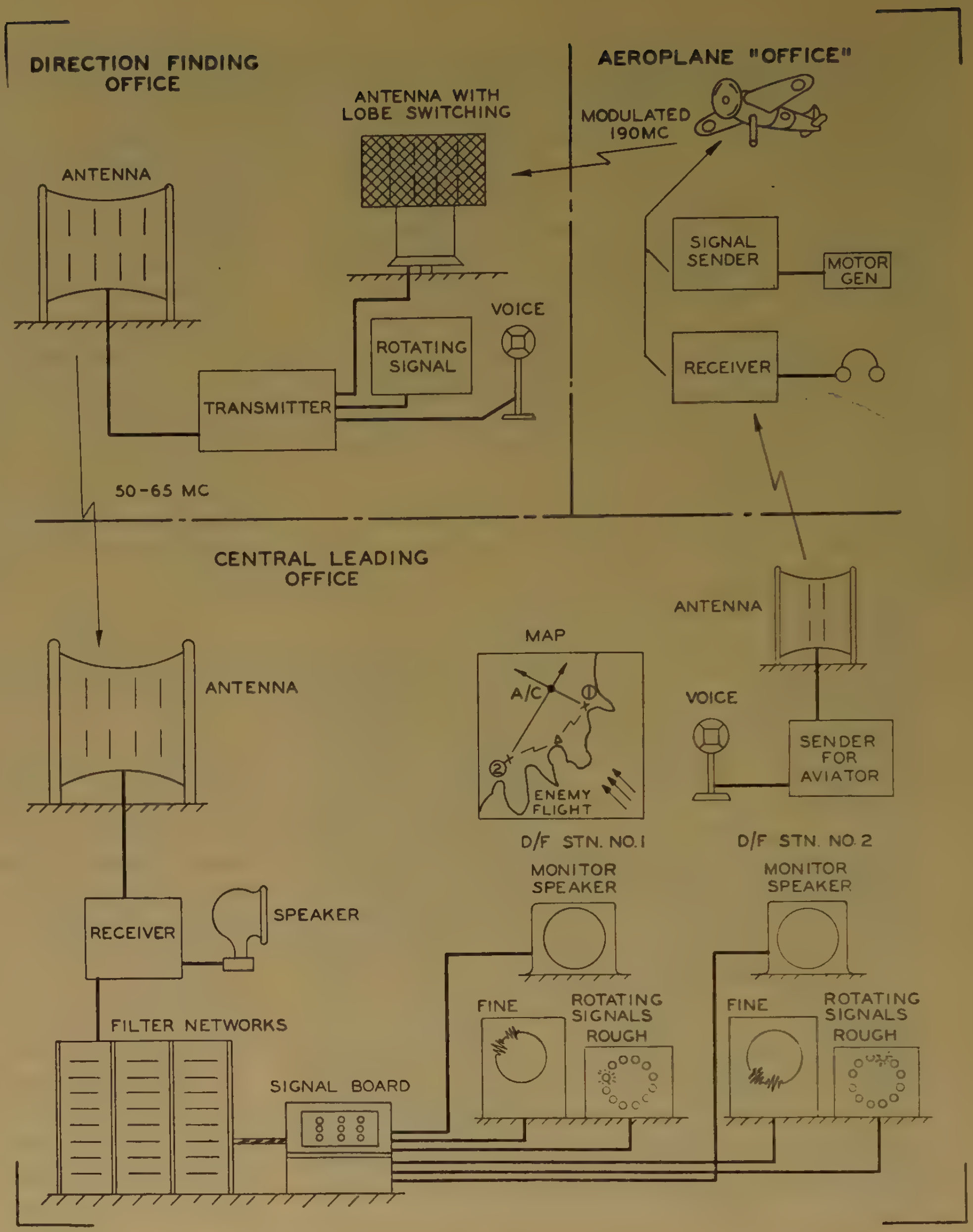


Figure 4. Tachi-28 multiple fighter control system

"On August 14th in this year, the war situation became too imminent to continue the research in laboratory even for our technical officers. We were obliged to prepare as we were able to go to the front to die—I dare say 'to die.' Thus at last we partialized and burnt down all our lovely sets (please pardon me to say 'lovely') with all important documents of investigations or experiments, and then we suddenly met the end of war before we went to the front as you know. I'm very sorry as one engineer that we partialized and burnt down to ashes all the sets and technical documents. I can say with my responsibility that we would have never burnt our lovely sets if we knew the war would end on August 15 at once, and you American Army or Air Forces would land such peacefully as we saw actually."

Paralleling the development of Taki-14 at 27 centimeters were studies at Tama Institute using the identical equipment with the radio frequency circuits altered to accommodate 10-centimeter transmitting tubes, thus producing Taki-24. At the same time, a 5-centimeter

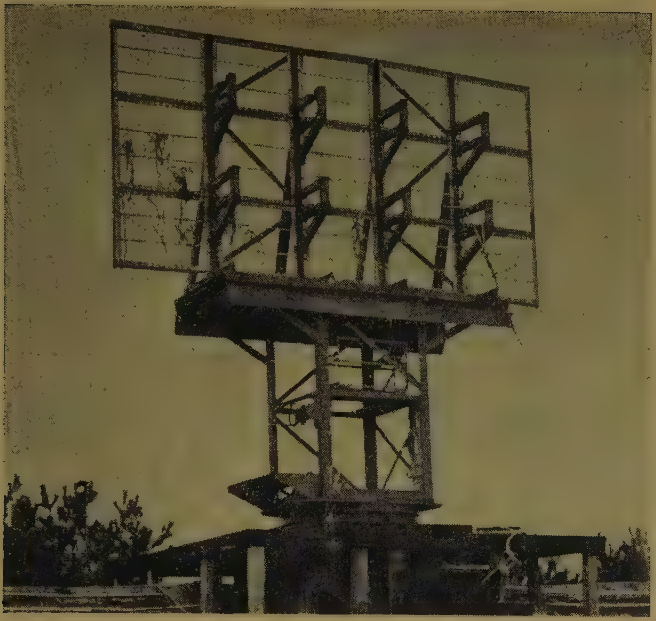


Figure 5. Direction finding antennas

set called Taki-34 was under development which used a magnetron for transmitting and a velocity-modulated tube for the local oscillator. A plan position indicator (PPI) presentation with sweep corresponding to the position of the paraboloid antenna was employed with magnetic deflection coils on the oscilloscope. It was developed after seeing the construction used on B-29's which had crashed over Japan. This set was turned over to Tama engineers in July 1945. It never was test flown, but experiments from a high point of land at Ajiro on the peninsula south of Tokyo showed the disappointing ranges of only 12–15 kilometers on nearby mountains.

LOCATOR-TYPE RADAR SETS

In 1942 one Japanese officer and two civilian engineers went to Singapore and Corregidor to inspect captured English and American radars. At Singapore they found the equipment almost entirely demolished. However, according to Japanese accounts, they discovered one complete set of drawings and specifications for a searchlight or fire control radar. At Corregidor several SCR-268's were captured, one of which was in complete operating order.

Tachi-1 and Tachi-2, the first two locators designed by the army, show strong indications of British searchlight control influence. Both are 200-megacycle sets, Tachi-1 having separately mounted transmitting and receiving antennas, while Tachi-2, as shown in Figure 3, has them together on the same mobile trailer mount. A phasing ring is used in both cases to give the receiver lobe generated by the four Yagi antennas a rotary movement. A mechanical distributor is used to switch the received signal at appropriate moments to the azimuth and elevation oscilloscopes. Tachi-3, which became the army's chief fixed position fire control reliance (150 were produced), was patterned after the British gun laying mark II equipment. It was rated at 50 kw at 78 megacycles and had a claimed range of 40 kilometers. Color disks were used for pip matching in both azimuth and elevation.

At a typical army antiaircraft defense layout, such as at Kawasaki, ten miles below Tokyo guarding the southern approaches to the capital, both Tachi-2 and Tachi-3 would be installed to control six 120-millimeter guns arranged in characteristic circular positions, and six 88-millimeter guns in a semicircular design. Tachi-2 often was camouflaged by a barn which rolled back on railroad tracks when the set was to be used. It is perhaps of interest to note that the Japanese navy acquired a Tachi-3 for experiment and comparison with navy fire control sets at their Chigasaki field laboratory. They found that it had greater range than their own S-3 and S-24 equipments, but that its bearing and elevation accuracies were not as good. Consequently, they considered their navy sets superior for searchlight and fire control purposes.

Tachi-4 was a mobile locator built to replace Tachi-2, but it proved unsatisfactory in operation. In this set the transmitter and receiver were combined to simplify the assembly. Finally Tachi-31 was built from modifications of Tachi-4 and became the standard 200-megacycle radio locator for the army. This 10-kw set used all four Yagi antennas for transmitting and receiving, thereby giving greater range and directional definition (range, 40 kilometers, azimuth and elevation accuracy plus or minus one degree).

At the same time that the 200-megacycle development was going on, slow progress was being made in building an exact copy of the German Small Wurzburg (Tachi-24), which would operate at a 50-centimeter wave length and give a much improved azimuth and elevation accuracy (in the order of one-eighth degree). Plans for this set and the major components had been brought from Germany by submarine in January 1944. Re-engineering to Japanese specifications and parts required several months, and the first of three sets to be made by Nihon Musen as models for the Sumitomo and Tokyo Shibaura companies to copy was nearing completion in August 1945.

In all of the foregoing fire control sets, the data are sent to mechanical gun directors by means of a Selsyn-type system.

The army just was beginning to produce a locator for use on aircraft as the war ended. This was Taki-2, an 80-centimeter set with a single Yagi transmitting antenna and four similar receiving antennas switched in rotation for azimuth and elevation estimating. It does not seeml ikely that this set would have given sufficient directional accuracy for much success as a night fighter.

Table I. Summary of Radar Equipment Developed by the Japanese Army

Figures Given Indicate Maximum and Minimum for Each Classification

Classification	Number of Types Designed	Objective	Frequency (Megacycles) or Wave Length (Centimeters)	Power Output	Range	Weight	Total Number Produced
Warning Radar							
Ground	9	Fixed and mobile aircraftwarning systems	68–106 megacycles	to 50 kw	to 300 kilometers	100 kilograms–18 tons (including vehicles)	825
Ship-borne	3	Detection of ships, aircraft, submarines	15.7 centimeters 150 megacycles	to 50 kw	to 300 kilometers	100 kilograms–4 tons	111
Air-borne	2	Detection of ships and submarines	150 megacycles	10 kw	to 100 kilometers	80–150 kilograms	1,000
Locating Radar							
Ground	6	Fixes firing data for antiaircraft guns	78–200 megacycles 50 centimeters	to 50 kw	to 40 kilometers	1.5–4 tons	341
Air-borne	2	Night interception	80 centimeters	2 kw	to 8 kilometers	120 kilograms	in production
Leading Radar (Offensive fighter aircraft directing)							
For single aircraft	2	Indicates position of friendly aircraft	175–184 megacycles	to 10 kw	150 kilometers	25 kilograms–1.5 tons	70
For several aircraft	2	Same	190 megacycles		300 kilometers	25 kilograms–500 tons	51
Directing equipment	3	Computes interception course and transmits it to airplane				20–500 kilograms	models completed
Identification—friend or foe	4	Identification of aircraft	175–184 megacycles	100 watts (airborne 10 kw (ground)	250 kilometers	25 kilograms (airborne) 1.6 tons (ground)	120 50
Navigation Radar							
Hyperbolic curve navigation equipment	2	Computation of two curved lines for navigational purposes	1.5 megacycles	150 kw	to 3,000 kilometers	50 kilograms (airborne) 600 tons (ground)	model completed
Night Radar	4	Identification of condition of terrain for bombing and navigation purposes	5–27 centimeters	2 kw	radius 20 kilometers at 5,000 meters altitude	120 kilograms	models completed
Radar altimeter	3	Computation of distance from aircraft to ground	375 megacycles Fm and pulsed	to 200 watts	to 50 meters and 12,000 meters	25 kilograms	in use
Search Receivers	4	Detection of enemy radar	3 centimeters–15 meters		to 300 kilometers	32–250 kilograms	50 sets in field
Radar jamming	2	Jamming of enemy radar	0.8-7 meters	continuous to 70 watts impulse to 1 kw		200 kilograms	10
Special equipment							
Special aircraft control	2	Guiding of gliders	200 megacycles			50 kilograms–2.5 tons	Under research
Homing equipment	2	Detection of, and adhering to, electric waves reflected or sent from ships	300 megacycles to 7.5 meters	70 watts	to 5 kilometers (expected)		Under research

ARMY LEADING RADAR FOR GROUND CONTROLLED INTERCEPTION

The Japanese were trying hard to solve the problem of ground controlled interception as the war ended. For this they had built a ground interrogator, Tachi-13, transmitting at 184 megacycles per second and receiving at 175 megacycles per second. This was to work with the transpondor Taki-15 installed in the airplane both to identify and fix the position of the night fighter. Display was on two *A*-oscilloscopes, one giving range, and the other giving bearing by means of pip matching. This would have been quite similar to using the American RC-184 for guiding an interceptor, something which could be done only with exceedingly skilled plotters and controllers. Presumably the 200-megacycle Tachi-31 or the Wurzburg (Tachi-24) would have been used for fixing the position of the enemy airplane at any moment.

In order to handle more than one air interception at one time, a combination of equipments called Tachi-28 was in the process of being built, by means of which as many as 30 friendly airplanes could be guided simultaneously (see Figure 4). Each airplane to be controlled carries a transmitter (Taki-30) radiating a continuous signal at 190 megacycles and modulated at some assigned frequency between 30 and 60 kc. Two or more direction finder (DF) stations located at intervals of about 50 miles pick up the signals. Their antennas (see Figure 5) rotate steadily at two revolutions per minute, and each is arranged by 50-cycle lobe switching to have a horizontal pattern with two maxima and a sharp minimum between them.

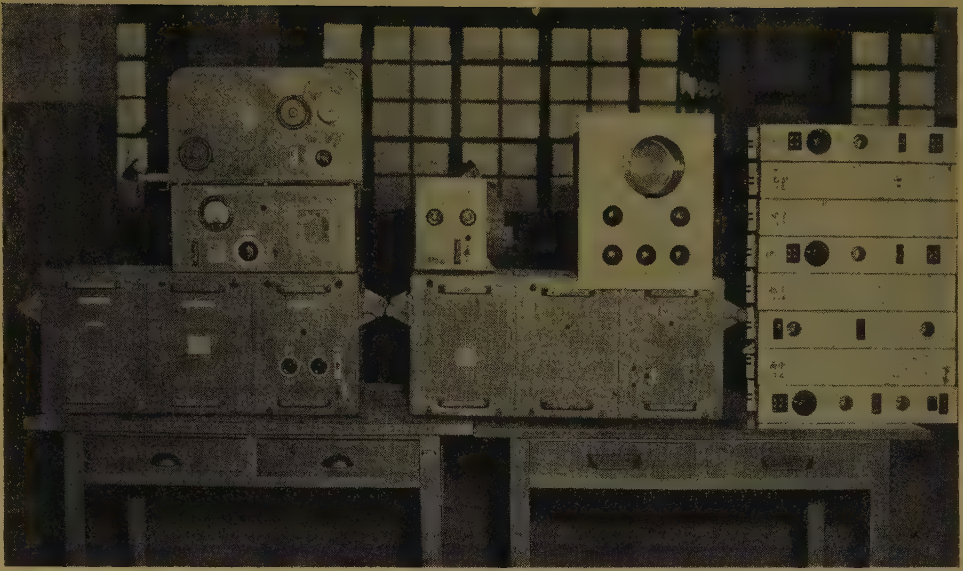


Figure 6. Tachi-28 central station equipment

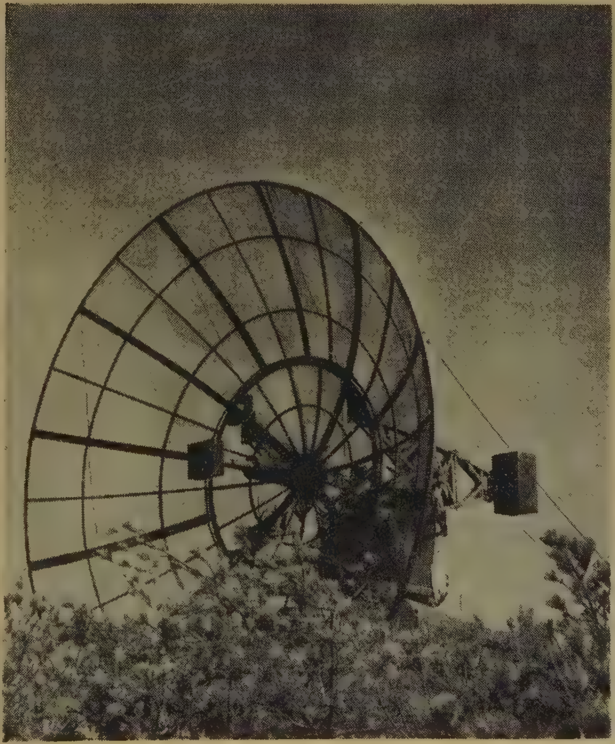
Left—Fine indicator, coarse indicator, auxiliary equipment
Center—Monitor oscilloscope, equipment to develop circular sweep
Right—Filters for airplane signals

The composite signal picked up by each direction finder station—a mixture of tones from 30 to 60 kc—is radioed to a control station on a special 5-meter link. (Some of the central station equipment is seen in Figure 6.) In the region below the lowest aircraft signal frequency (from zero to 30 kc) a voice channel and an azimuth signal are transmitted. The latter indicates the position of the direction finder antenna and is in two parts: one, for fine data, is continuously variable and repeats itself every 30 degrees; the other, for coarse data, varies in 12 steps. At the central station the coarse azimuth signal lights one of 12 neon lamps, while the fine azimuth signal positions the spot of a cathode ray tube causing it to go through a circle for each 30 degrees of the direction finder antenna's travel. The signal of the particular airplane being observed is selected by a filter and displayed radially on the cathode-ray tube. The minimum in the center of the observed figure which appears on the oscilloscope is at the azimuth of the airplane. The operator locating an airplane has two oscilloscopes before him, one for each of the two outlying direction finder stations. From the data of both stations he can locate the airplane quite accurately. Other operators use the same azimuth signals but select different aircraft signals.

This system was intended for ground controlled interception use and the first units were being installed in the Tokyo area as the war ended. The central station was located at Matsudo; initial direction finding stations were at Choshi and Shirahama, 50 miles east and south, respectively, of Tokyo. In some cases relay stations were to be used in the 5-meter radio link. This system is of possible interest to American engineers studying airport and airway traffic control as it provides instantaneous remote indications of a large amount of data: two direction finder cuts a minute on each of 30 airplanes.

The transpondor used with the Tachi-13 previously mentioned is really an identification-friend-or-foe set and ordinarily would be used with the Tachi-13 or Tachi-17 on the ground as the interrogator–receiver in the projected identification-friend-or-foe system. Tachi-17 is a simplified Tachi-13 giving considerably less directional accuracy.

There is considerable doubt that the foregoing measures would have gone very far toward solving one of Japan's most urgent problems: how to knock the B-29's out of the sky in such numbers as to interfere seriously with their bombing operations. Even the United States forces, with their much superior plan position indicator oscilloscopes for ground controlled interception, and their 10-centimeter airborne radar interception, would have had great difficulty in slowing down such an attack.



50 Years of Physics

GORDON F. HULL

In the years prior to the 20th century the names of American physicists, with two or three notable exceptions, were conspicuous by their absence from any roster of world-acclaimed scientists. The discovery of the X ray in 1895, however, marked the beginning of a new epoch in physics and during the succeeding 50 years Americans gradually attained eminence in this field. Today, as a result of the developments coming out of the United States during World War II, as well as the war's disastrous effect on scientific progress in other countries, at least three-fifths of all the physics activity in the world is centered in the United States.

THERE HAVE BEEN two transcendent periods in the domain of physics during these past 50 years. The first began with the discovery in 1895–96 of X rays, followed by the discovery of the Becquerel rays in 1896, the electron in 1897, radium in 1898, and the statement of the quantum theory by Planck in 1900. The second period also began in 1896 but, slowly growing, culminated in 1939. Vast vistas suddenly were opened in 1896. There had been no theory or experiment which had foretold the discovery of X rays. A similar statement may be made concerning radioactivity and the quantum idea. The timeliness of the discovery of X rays and the electron is shown by the fact that two of the three kinds of rays which came from a complex radioactive source could be explained at once. The nature of the third ray, though quickly postulated by Rutherford, was not established convincingly until the Rutherford and Royds experiment in 1908. Then the process of transmutation of the elements as it occurs in nature was made plain. The way was open for all the vast results which have followed.

AMERICA'S CONTRIBUTIONS

It is not the purpose of this article to attempt to record the progress of physics in all its great domains during these years but only to present a few contrasts.

It has been noted that no American physicist participated in any of the great discoveries which have been mentioned.[1] Perhaps that statement should be modified as will be indicated later.

In 1899 Arthur Gordon Webster, a distinguished Harvard graduate and one of the most prominent American physicists, called together the leading physicists, chiefly of the east, for the purpose of organizing the American Physical Society. Appropriately, Henry Rowland was elected president and A. A. Michelson, vice-president. When Rowland was retiring, he named, in his address, the only four American physicists who, in all the previous history of America, had won world-wide fame for their contribution to physics—Franklin, Rumford, Henry, and Mayer. The many-sided Franklin, a legendary figure, had won fame along various lines. Had he not been famous as a publisher and a statesman (at 80 years of age he was still the United States' chief maker of treaties) he might never have been heard of as a scientist. Balzac described him as "the inventer of the lightning rod, the hoax, and the republic." It has been maintained that there is no clear evidence that he ever performed the kite experiment and it is certain that the experiment was performed elsewhere before Franklin wrote of it as a possibility. In any event, Franklin's work in science did not lack for publicity.

Rumford left America as a very young man. He was always a British subject and did all his scientific work in Europe. He hardly could be called an American scientist. However, he was interested in the development of science in America as is evidenced by the Rumford Medal of the American Academy of Arts and Sciences, the Rumford Fund of that academy, and the Rumford Professorship in Harvard University.

Joseph Henry's work in electromagnetic induction was substantial, but was overshadowed by the work of Faraday.

Who was Mayer? Many physicists do not know, but A. M. Mayer (1836–1897) was professor of physics at Stevens Institute and was the coauthor of a very modest text (112 pages) on light. His contribution to physics does not seem to have been recorded in any history of physics. The fame of a teacher is likely to be transient.

Rowland's list then of American physicists who, before his time, had made substantial contributions, boils down to two names—Benjamin Franklin and Joseph Henry. Had he included living Americans he would have added two more, himself and A. A. Michelson. The contributions of these two men have been acclaimed by the entire world. Rowland's experiment on the magnetic effect of convection currents, begun in

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Essential substance of an address before a meeting of the American Physical Society, Cambridge, Mass., April 25–27, 1946.

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Helmholtz' Laboratory, made clear to J. J. Thomson the nature of the electron. To that extent an American physicist participated in the discovery of that particle. Rowland's exhaustive experiment on the mechanical equivalent of heat was financed by the Rumford Fund of the American Academy of Arts and Sciences and his extensive paper was published in the proceedings of that academy. He had had difficulty in finding an American publisher for some of his earlier papers but Clerk Maxwell came to his rescue and had them published in the *Philosophical Magazine.*

In addition to these discoveries, by 1900 American physicists had contributed the design of the concave grating; the building of an excellent machine for ruling gratings (the machine which still is ruling gratings for the world); the Michelson-Morley experiment (perhaps the most important experiment ever to be performed in America); and the measurement by Michelson of the French meter in wave lengths of cadmium light, an experiment carried to a precision which never has been exceeded,* a precision of one part in 20 millions.

EUROPE AS MENTOR

Fifty years ago graduate training in physics was looking up in America but it still was true that every young physicist believed it necessary to spend at least a year in Germany or in the Cavendish Laboratory in Cambridge. Europe was the source of inspiration. Ideas came from Europe as well as 90 per cent of all apparatus in American physical laboratories.

However, not only were the leading laboratories in the United States rapidly expanding, but two in Canada, Toronto and McGill, were being heard from. In 1898 the 27-year-old New Zealander, Rutherford, came from Cambridge to McGill University as research professor in physics. Soddy came from Oxford to join him in 1900. Together, in 1902, they put forth the startling theory that radioactivity was a spontaneous natural process of transmutation of certain elements. This idea seemed so preposterous that the authorities of McGill University were afraid that the university would be held up to ridicule. But the physicists of the world presently were convinced that the theory was right and McGill University became a mecca for workers in radioactivity. Among those who came was Doctor Otto Hahn, in 1905, who, with Strassmann in January 1939, made the announcement which was to have such world-shaking effects—that uranium atoms bombarded by slow neutrons break up so that barium is produced. The explosion of the atomic bomb was an eruption which, in physics, had been gathering force for 40 years. The rest has been told in millions of words in the press and journals since August 6, 1945.

To show that no artificial dividing line separates the physicists of one nation from those of another, an amusing incident may be told which occurred during the year or so that Hahn was at McGill University. A photographer came to the laboratory to photograph Rutherford for *Nature.* Rutherford's shirt, however, had no cuffs to speak of and the photographer was shocked. Hahn had a pair of detachable cuffs. These were slipped under Rutherford's coat sleeves and the photographer's sense of dignity was satisfied. In the photograph the face is that of Rutherford but the white cuff so prominently displayed belonged to Hahn. Years later, recalling the inspiring period he had spent in association with Rutherford, Hahn writes of this incident as "one of the beautiful memories of my life."

Although the "genealogical tree" of the radioactive products of uranium had been set forth in 1902 on the basis that the alpha particle was a helium atom of charge two and mass four, there was still doubt about it when Rutherford left McGill University for Manchester in 1907. In a letter to Hahn in 1907 Rutherford writes that "it may yet turn out that the alpha particle is hydrogen and that helium comes from a rayless product." The author made this proposal in 1904 when Rutherford lectured at Dartmouth College and doubtless it has been made numerous other times but within a year after reaching Manchester, Rutherford and Royds proved the helium idea the right one. In this same 1907 letter to Hahn, Rutherford expressed pleasure at the prospect of getting back to England for, he wrote, "I shall be glad to be nearer the scientific center as I always feel that America as well as Canada is on the periphery of the circle." What would he say now with at least three-fifths of all the physics activity in the world centered in the United States!

To see what a long road it was from the discovery of radium in 1898 to that of the fission of uranium in 1939 one may follow Rutherford's career in Manchester and Cambridge. Hans Geiger had been an assistant of Professor Schuster in Manchester and was retained as Rutherford's assistant. As a result, in 1908, the Rutherford and Geiger device for counting alpha particles was evolved. Later, in Germany, Geiger improved upon this device and still later, 1928, the Geiger–Muller counter was brought out. This instrument enables the measurement of electric currents to the absolute limit of smallness. A person can be given food containing radioactive atoms and, at a later time, this counter can find the chief concentration of those atoms in the body.

Rutherford for some time had been wondering about the structure of the atom; whether it was like the "pumpkin" atom of J. J. Thomson, or whether it was a solar nucleus with electrons outside. Nagaoka had suggested a "saturnian" atom, a central massive portion with a ring of negative electrons. Rutherford worked out the theory of the scattering of alpha particles on the basis of the nuclear idea and Geiger, later Geiger and Marsden (1912), tested the theory by counting the number of alpha particles scattered at various angles.

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* This precision may be surpassed in the future by using the green line of the new isotope of mercury.

Their results supported the nuclear idea. Niels Bohr spent some months in Manchester at this time and was quick to use the new picture of the atom in his famous theory of the spectra of hydrogen. Moseley, who was with Rutherford for three years, also confirmed the nuclear view and established, in 1913, the concept of the atomic number, the number which has been used ever since to identify chemical elements. Moseley, who accomplished more in his brief lifetime than most scientists who live three score years and ten, was killed at Gallipoli in August 1915 at the age of 27.

EFFECT OF WORLD WAR I

When World War I intervened to check ordinary scientific research, Rutherford, Hahn, and Geiger, who had gone back to Germany, corresponded during the war by roundabout methods, all letters showing continued respect and cordial good will. In contrast with this evidence of friendship, one does not hear of any friendly letters during World War II from a German scientist to a scientist outside Germany. The reason is not difficult to discover. The scientists left in Germany, for the most part, felt that they belonged to a superior race. Those who did not have that belief dared not write.

Chadwick carried on research with Geiger in Germany just before World War I then was interned during the four war years but was treated well. Geiger's letters to Rutherford always gave assurances to that effect.

In 1919 Rutherford discovered that a nitrogen atom bombarded by an energetic alpha from radium could be transmuted into a new oxygen atom and hydrogen. The laborious method of observing the scintillations of a fluorescent screen was used to detect this result. For the first time in man's history the atom of a *stable* chemical element—the imperishable element of the chemists—was transmuted into another. The projectile used in this experiment was man-directed, but not man-made. It was a projectile provided by nature, its initial energy could not be altered in any way by man. But if great and various energies could be given to various kinds of atoms what might happen? Cockroft and Walton (1932) in the Cavendish Laboratory were able to speed up hydrogen nuclei to an energy of only 150,000 volts and by directing these against lithium found that two helium atoms had been formed. Not only were new atoms formed, but apparently energy had been created, for the two helium nuclei together had an energy of 17,000,000 volts. What had happened was that the loss of mass resulting from the formation of the two new atoms had taken the form of energy—a concept which had been growing for some time. Einstein's historic equation, $E=mc^2$, had been verified.

THE AMERICAN PHYSICAL SOCIETY

To return to the paleozoic age of physics in America, the American Physical Society was formed with 37 members, some of whom were not physicists. There were to be four meetings a year, each meeting consisting of two sessions, one morning, one afternoon. In the first five meetings there was a total of 28 papers, three or four in the morning, three or four in the afternoon, and there was plenty of time for the papers and for discussion. At times R. W. Wood who had succeeded Rowland at Johns Hopkins University (1901) and who was known throughout the world as a brilliant experimenter gave some demonstrations of optical phenomena. Here a tribute should be paid to Wood for his many contributions to optics, for his outstanding text on physical optics, for his near discovery of the Raman effect, and for his exposure of Blondlot's claims regarding N rays.*

The proceedings and papers of the society were published in bulletins, four per volume. Volume one, covering the first two years, had a total of 80 pages. But at Cornell University E. L. Nichols and Ernest Merritt had started the *Physical Review* in 1894. This was taken over by the society in January 1903 and since then has been the chief official publication and a leading physics journal.

Just before Rutherford left Canada, O. W. Richardson came from Trinity College, Cambridge, to Princeton University from which the Comptons presently emerged. At the same time Pupin and others were building up Columbia University not only by their own work but by capturing prominent physicists for their department. They tried to get both J. J. Thomson and Rutherford there together in 1901 but neither would think of going to so isolated a place as the city of New York.

The sensational discoveries during the closing years of the 19th century energized the work in physics of all the great universities of America. Perhaps this was especially true of the University of Chicago where the name of Michelson and the energy and enthusiasm of Millikan attracted many graduate students. The measurement of the electron charge by the oil drop method and of Planck's constant by the photoelectric effect brought new precision at that time to those quantities. The graduates of the University of Chicago were destined to fill very responsible positions in the universities and in the great industrial laboratories.

Then Washington University stepped into the limelight. There A. H. Compton (1923) measuring the wave length of X rays scattered by matter found that the wave length was lengthened slightly and he gave an explanation of the effect based on Planck's quantum theory. Both his experimental results and theoretical reasoning were disputed by others but he conclusively proved his case.

The Compton effect made it clear that bullets of light, particles of radiant energy, photons, possessed momentum and energy, that waves of light have the properties of particles. At once, by simple mechanics, the result could be derived that light would give momentum to atoms or would exert pressure on a surface on which it fell, a pressure equal to the energy density in front of the surface. This latter conclusion had been derived by Maxwell from his electromagnetic theory and had been discovered experimentally by Peter Lebedew in Moscow and with considerably greater precision by E. F. Nichols and G. F. Hull in the opening years of the century.

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* Blondlot of the University of Nancy in 1904 received a prize of 50,000 francs for the discovery of the N rays. Wood visited his laboratory, removed in the semi-darkened room some of the "essential" components of the apparatus. Blondlot still saw the screen light up."

An industrial laboratory stepped into the picture when Davisson and Germer (1927) of the Bell Telephone Laboratories proved that an electron possesses wavelike characteristics. G. P. Thomson in Aberdeen arrived at the same result nearly simultaneously. These experiments supplemented Compton's work and proved that particles have the properties of waves. They confirmed the theoretical work of Louis de Broglie.

All eyes turned toward India when Raman (1928) showed that light scattered by matter might differ in wave length from that of the original beam by amounts which could be explained by the quantum theory but which were completely unintelligible on the basis of the wave theory. India, which had had no place in physics at the beginning of the century, now attained and has continued to hold an honored position.

PHYSICS WONDER YEAR

The year of 1932 was a wonder year in physics. Chadwick discovered the neutron; C. D. Anderson discovered the positron; Urey, Brickwedde, and Murphy discovered heavy water; Cockroft and Walton brought about the transmutation of lithium by firing hydrogen nuclei into it; the latitude effect in cosmic rays was discovered; Van de Graaff devised his generator for high voltages; and E. O. Lawrence, with the help of his associates, brought the cyclotron to practical performance. The cyclotron since has grown to such dimensions that it may require an entire building to house it and three or four teams of specially trained physicists to operate it by remote control day and night and may, with its housing, cost as much as $2,000,000. Compared with Cockroft and Walton's 150,000 volts, it may give atoms speeds of 60,000,000 volts.

Of the seven afore-mentioned discoveries, two were produced in England, five in the United States. True, the two English contributions were of very great importance. Neutrons are known to be an important part of nature. In number or mass they are the chief constituents of all atomic nuclei, they are extremely effective bullets in breaking up atoms, and they are the detonators in atomic bombs. But the cyclotron is also of importance. By its means every known element has been transmuted into another.

Other discoveries were that of artificial radioactivity by the Curie-Joliots in 1934 and of the mesotron in 1936 by Anderson and Neddemeyer of the California Institute of Technology and by Street and Stevenson of Harvard University.

In 1934 Fermi and his numerous associates in Rome believed that by bombarding uranium by slow neutrons they had produced element 93. But they did not prove their case; indeed, there was great doubt about it. Hahn, Meitner, and Strassmann took up the problem and came to various conclusions, among them that transuranic elements as far out as 97 had been produced. Irene Curie and Savitch in 1937 thought that they had found lanthanum in the material but concluded that it must be a new transuranic element, 93, which had properties similar to lanthanum. (This would be reasonable inasmuch as the atomic number of lanthanum is 57. $57+36=93$.) Then in January 1939, Hahn and Strassmann announced that the analysis of the material obtained by bombardment showed that barium was present. It was not there before the bombardment. It was not a transuranic element; it was barium, and if barium was present, so probably was krypton. That announcement produced an enormous upheaval in the domain of physics for never before had a heavy atom been broken up into two atoms roughly equal in mass.

Aston in his pioneer work with the mass spectograph had measured the masses of many atoms and had drawn a curve called the packing fraction curve showing the masses of the atoms. This was extended by Dempster so that competent physicists knew the masses of uranium, barium, and krypton. They knew the excess mass of the large atom over the sum of the two smaller masses and by a simple mental operation they could compute the energy which would result. This computation was made almost immediately by Lise Meitner and Frisch. Early in 1940 A. O. Nier separated, by the mass spectrograph, U-234, U-235, and U-238. Dunning, Booth, and Grosse proved that it was U-235 that was broken up. Then the great reservoir of power of the physicists of America and England broke loose to bring about in five years a result—the production of the atomic bomb—which at first thought would require 100 million years for its completion. For part of this story, a story with no counterpart in the history of man, the reader is referred to the Smyth report.

PHYSICS DURING WORLD WAR II

Some discoveries were made during World War II which should be included. In 1939, in the Berkeley laboratory, Edwin McMillan tentatively identified elements 93 and 94 (of mass 239) in uranium bombarded by slow neutrons. In 1940 he and Abelson made the matter certain. The names proposed by McMillan were neptunium (Np) and plutonium (Pu). Later in that year uranium was bombarded by 30-million-volt deuterons from the cyclotron and the 238 isotopes of these elements were obtained including enough of plutonium (0.5 milligram, one millionth of a pound) to enable Seaborg, Kennedy, and Wahl to make a study of its chemical properties. Had plutonium not been discovered there still would have been no atomic bomb.

Another discovery was that by Seaborg of elements 95 and 96, for which he proposed the names americum and curium. These elements complete a list of eight chemical elements which were discovered, during the war, by physical means: elements 43, 61, 85, 87, 93, 94, 95, and 96. Incidentally, handbooks of physics and chemistry and charts of chemical elements list elements 85 and 87 as alabamine and virginium. These names must be striken out inasmuch as the magneto-optical method of identifying chemical elements, like the N rays, is an exploded fallacy.

A cyclotron may produce more radioactive atoms and bring about more transmutations than would be produced by all the radium in the laboratories of the world, and, in the very near future, uranium-plutonium piles or nuclear reactors may be available which may provide neutrons and gamma rays of great intrinsic energy and of unparalleled intensity.

However a new device, the betatron, for producing high energy particles, in this case electrons, has been developed by Kerst. One such instrument in the research laboratory of the General Electric Company gives to electrons an energy of 150,000,000 volts. The resulting X rays penetrate a foot of steel, produce transmutations, and generate mesotrons, thus providing man-made cosmic rays generated on the earth. However, both the cyclotron and betatron may be superseded by the synchrotron which promises to obtain energies of 300 million volts. This idea, proposed in 1945 by McMillan in Berkeley, seems to have been proposed previously by V. Veksler of Moscow in 1944 who is building a 30-million-volt instrument in that city.

STATE OF PHYSICS TODAY

What is the condition of physics today? In Germany, Japan, and parts of Russia science nearly has been destroyed. In France and England it has been curtailed greatly. In the United States, however, physics has reached a pinnacle never before attained. During the first 20 years of the Nobel prize awards only one American, A. A. Michelson, received the prize, and that was for work done 20 or more years earlier. Of those who received the awards in physics during the past 25 years, 12 are in America; and of the last nine medalists, eight are in America, four of whom are native-born. Half of America's Nobel prize winners in physics are recent arrivals from Europe, and there are other rather recent arrivals who are not inferior to some of the prizemen. All of these plus native American talent have given to research and teaching an unchallenged prestige. America's young men no longer feel that it is necessary to go abroad for thorough training or for opportunities for research. On the contrary, before the war there was an increasing number of applicants from abroad for admission to American graduate schools. In fact, so great has been the number of applications of students from abroad that some of the universities in America have had to impose a quota system so that native-born students would not be crowded out.

Of course membership in American physical societies has increased. Instead of the 30 or 40 members of the parent society in 1899 there are now 5,300 members in it and related societies (optical, acoustical, X rays, electron microscope, and physics teachers), a total of 10,000 or about 300 times the original membership. And instead of 20 or 30 papers a year there are now several thousand.

There has been a corresponding increase in research activities in universities and technical schools. It ought to be recorded that during these 50 years the number of students in American colleges and universities has increased by a factor of seven. For example, the Massachusetts Institute of Technology, originally purely an undergraduate technical institution, now is one of the foremost institutes of technology in the world. Originally research in pure science was out of bounds but gradually its field broadened. During the first 20 years of this century the institute awarded a total of four masters degrees and two doctors degrees in physics. Now it has 150 graduate students including those in three groups; the research laboratory in electronics, the laboratory of nuclear science, and the acoustics laboratory.

During the war the Massachusetts Institute of Technology cosponsored the Radiation Laboratory which, next to the Manhattan Project, was the greatest enterprise of the war with operating expenses of approximately $3,000,000 a month. In that laboratory numerous radar devices were designed and brought to perfection. The H2X air-borne set carried by heavy bombers so that targets could be found at night or through overcast, the Loran sets for long range navigation with which any vessel or airplane carrying a receiver could locate its position without chronometer or astronomical observation, the powerful MEW (microwave early warning) set which played so large a part in the invasion of Europe all came from the Radiation Laboratory. It should be noted here that the multicavity multiresonant magnetron essential in many radar devices is due to Oliphant of Birmingham, and the idea for the original magnetron to A. W. Hull of the General Electric Research Laboratory.

The University of California, on the Pacific coast, enrolls about 4,000 students in the undergraduate physics courses (3,000 different students), and at last report there were 120 graduate students and 100 clamoring for admission. These figures do not include the radiation laboratory of the monster cyclotrons. At present no information regarding that laboratory is available because it is under government control.

The California Institute of Technology has risen to a leading place among the world's physics research laboratories with 300 undergraduates in physics and 80 graduates. Fifty years ago these figures were 12 and 0. On its physics faculty of 13 full professors there are two Nobel prize winners, one third of all the native-born American prize winners in physics. The California institute's great growth and prestige can be attributed to R. A. Millikan who has been its chief for 25 years.

In a brief survey only a few men can be named and so many may be offended. Among these may be mentioned the contributions of Theodore Lyman and Bridgman; Harrison and Slater; Aston, Dempster, and Bainbridge; Boltwood, Bumsted, and Swann; C. T. R. Wilson; Dirac; Schroedinger; Heisenberg and Bethe; J. A. Wheeler; and of many others.

THE FUTURE OF SCIENCE

The wonders of radar in all its forms, completely unknown 50 years ago, the discovery of the fission of uranium by Hahn and Strassmann, the production of the atomic bomb (about which this article says little in comparison with the millions of words that have been printed about it) by the combined scientific power of the United States and England, by the Canadian contribution of the essential materials, and by the vast industrial power of the United States, have given to American physicists a prestige never before enjoyed.

These scientists are not combative or competitive as are other social or economic groups and so should unite with the scientists of all other nations to outlaw war. No iron curtain should be allowed to enclose and segregate the scientists of any nation.

Science has attained a prominent place in the life of the nation but the methods of science have not changed greatly, although it is true that there is emphasis on teamwork in contrast to the efforts of an individual. Great laboratories supplied with very powerful and expensive apparatus can dwarf the work of ordinary college laboratories.

But what kind of people are you going to put into the large laboratories? What ideals are you going to place before them? Merely bringing a lot of men together in one building or center is not necessarily going to bring about progress in science. How did it happen that Chadwick discovered the neutron? He knew from Compton's work what a photon would do if it struck an atom. He knew from long established principles what an atom would do if it struck another atom. He could identify atoms by their ranges from the abundant data established by the labors of Rutherford, Blackett, and by himself. He possessed a great fund of knowledge. He possessed experimental skill and he was a tremendous worker. Would he have been helped or hindered by a lot of clock punchers? It is of vast importance that every teacher of physics in the colleges and universities be impressed with the view that progress in science depends on *his* knowledge of the domain in which he works, *his* scientific curiosity, *his* scientific imagination, *his* experimental skill and analytical ability, and that progress is likely to be accompanied by the scientific analogues of blood, sweat, and tears.

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2. *Journal* of the Franklin Institute, 1907, page 164.

New Process Polishes Silver Electrolytically

A process of polishing metals by electrolytic treatment now has been adapted for application to silver. In this method of "electroplating in reverse" a current opposite in direction to that employed for ordinary plating removes metal preferentially from the high spots to produce a mirror-smooth surface. It replaces manual and mechanical buffing.

Electropolishing in general is a relatively new finishing procedure which has developed during the last ten years. The most important application so far has been the polishing of stainless steel, and several large installations have been operating with strong acidic baths for a number of years. Aluminum, zinc, copper, brass, nickel, tin, cobalt, nickel-silver, and various iron alloys also can be polished in acid baths. However, these baths usually require a rather high current density which requires expensive equipment.

The new silver process differs from earlier methods for other metals in its simplicity and economy. Its alkaline cyanide bath is much the same as for silver plating and does not require heating. Current density also is in the low plating range, and plants thus may use their regular equipment. Inasmuch as electrical efficiencies are almost 100 per cent, power costs are very low, and silver continually is recovered from the bath, which thus has long life.

The process has been in use for polishing plated silverware at Oneida, Limited, for more than a year. The company also, as a result of research, has sponsored a project at Arthur D. Little, Inc., Cambridge, Mass.

The Automatic Sequence Controlled Calculator—I

HOWARD H. AIKEN GRACE M. HOPPER

With the increasing need for accurate computation occasioned by the use of numerical analysis in many scientific developments, as well as by the increased accuracy of physical measurement, more and more time and effort must be devoted to computational labor which is, moreover, always susceptible to human fallibility. As a step toward remedying the situation, the automatic sequence controlled calculator will carry out any selected sequence of the five fundamental operations of arithmetic (addition, subtraction, multiplication, division, and reference to tables of previously computed results) under completely automatic control. Part I of a 3-part article describes the mechanism and explains its function in addition and subtraction.

THE DESIRE TO economize time and mental effort in arithmetical computation, and to eliminate human liability to error, is probably as old as the science of arithmetic itself. This desire has led to the design and construction of a variety of aids to computation. After the invention of the abacus (about 3500 B.C.) 5,000 years elapsed before the next computing device was developed. During this time, gears and pointers were used in the design of clocks. These machine elements, and more especially a wheel which gave impetus to a second wheel at the end of a complete revolution, paved the way for the development of calculating machinery.

It was Blaise Pascal[1,2] who, in 1642, designed and built the first mechanical adding machine in the modern sense of the term. This machine depended upon the use of rotating wheels and provided for carry by mechanically turning the wheel of next higher order one position when the lower passed from nine to zero. The direct actuation of a numbered wheel and the secondary feature of effecting carry (which seem to have been used first in an adding machine by Pascal) are the foundation on which nearly all mechanical calculating machines since have been constructed.

Naturally, any machine designed for addition also may perform subtraction by means of complementary numbers. The complement on ten of a number is that second number which must be added to the first in order to obtain a power of ten. This complement on ten may be read off from left to right by taking the complement on nine of each successive digit except the last on the right, of which the complement on ten must be taken. Thus the complement on ten of 7,528 is 2,472. To subtract 7,528 from any number, for example 38,421, one may write

$$38{,}421-7{,}528=(38{,}421-10{,}000)+(10{,}000-7{,}528)=28{,}421+2{,}472=30{,}893$$

This procedure may be simplified further by the use of complements on nine and "end around carry."[3] End around carry implies carry from the highest column of a machine to the lowest column of the machine. The complement on nine of 7,528 in a 6-column machine is 992,471. Subtraction now becomes

$$038{,}421+992{,}471+000{,}001=030{,}893$$

where the third term, 000,001, is supplied by end around carry.

If any number, for example 007,364, is added to 999,999, operation of the machine will yield

$$999{,}999+007{,}364+000{,}001=007{,}364$$

where the third term is again the result of end around carry. Since, under these conditions, 999,999 is a number with the properties of minus zero for machine purposes, the complement on nine of any number may be adopted as the negative of the number. Clearly, an n digit calculating machine must be supplied with $(n+1)$

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Design and construction of the automatic sequence controlled calculator was begun in 1939 at Endicott, N. Y., and continued until August 1944, when the machine was presented formally to Harvard University by T. J. Watson, president, International Business Machines Corporation. Commander Aiken wishes to express his appreciation to Mr. Watson for the support of International Business Machines Corporation during the years of development of the calculator and further to B. M. Durfee, F. E. Hamilton, and C. D. Lake, who, together with Commander Aiken, were coinventers of the machine. The relays, counters, cam contacts, typewriters, card feeds, and card punch employed in the calculator are all standard parts of tabulating machinery as constructed by International Business Machines Corporation.

The opinions or assertions contained in this article are the private ones of the writers and are not to be construed as official or as reflecting the views of the Navy Department or the naval service at large. Material for the article has been adapted largely from "The Manual of Operation of the Automatic Sequence Controlled Calculator," *Annals* of the Computation Laboratory of Harvard University, volume I, Harvard University Press, Cambridge, Mass., 1946. Permission to use this material has been granted.

columns, the highest being reserved for the algebraic sign, and zero and nine being positive and negative respectively.

The next major development in mechanical aids to numerical computation was brought about in 1666 when Samuel Morland[4,5] built a machine similar to Pascal's, but which was adapted to multiplication by repeated addition. Independently, in 1671, Leibnitz[6,7,8] conceived a multiplying machine and finished it in 1694. In Pascal's machine the wheels were set and turned individually by hand; in Leibnitz' machine all wheels were set and turned simultaneously by a crank to a previously determined position. In the "stepped reckoner," Leibnitz added a device which still is used as a component part of modern calculating machines.

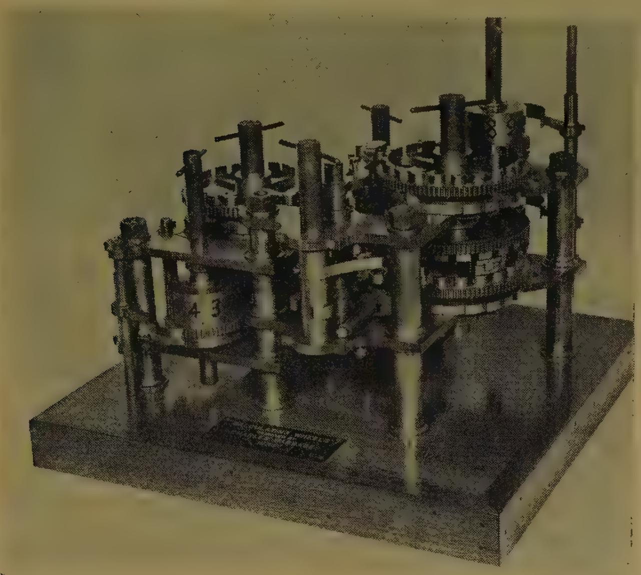

Figure 1. Calculating wheels designed by Babbage, 1834

It was not until just before the beginning of the 19th century that any attempt was made to build highly specialized calculating machines designed for the mathematical and physical sciences. A Hessian military engineer, J. H. Müller, [9,10,11] seems to have had the first idea for a difference engine in 1786. But this idea remained in a purely theoretical state and undoubtedly was forgotten until, in 1812, it occurred to the philosopher, Charles Babbage, and he began the actual construction of such an engine.[12,13] Figure 1 shows a fragment of Babbage's difference engine, preserved in the Computation Laboratory of Harvard University in Cambridge, Mass. This engine was to "perform the whole operation (the computation and printing of tables of functions) without any mental attention when once the given numbers have been put into the machine."[14] A first model was built between 1820 and 1822 which consisted of six columns using second differences. In 1823, the construction of an engine using 26 significant digits and sixth differences was begun with the aid of a subvention from the British government. The construction continued until 1833 when government aid was withdrawn. The major part of the unfinished machine is preserved in the collections of the South Kensington Science Museum in London, England. It should be remembered that the difference engine, although a highly useful scientific instrument, was still a specialized machine intended solely for tabulating the values of a function for equidistant values of the argument.

THE ANALYTICAL ENGINE

In spite of being unable to complete the difference engine, Babbage embarked upon the creation of a far more ambitious concept, an "analytical engine."[15,16,17] Though the terms of the problem proposed were enough to stagger contemporary imagination, he attempted to design a machine capable of carrying out not just a single arithmetical operation, but whole series of such operations without the intervention of an operator. The numbers in the first part of the machine, called the "store," were to be operated upon by the second part of the machine, called the "mill." A succession of selected operations was to be executed mechanically at the command of a "sequence mechanism" (a term unknown to Babbage). For this latter mechanism, he intended to use a variation of the Jacquard cards.[18] These cards, the precursors of Hollerith's punched cards, were used by the Jacquard weavers to control their looms in order to produce and reproduce the patterns designed by the artists.

In the adaptation of these cards for use in his machine, Babbage required two decks: one of variable cards and one of operational cards. The first set was designed to select the particular numbers to be operated upon from the store; the second set, to select the operation to be performed by the mill. As the deck of operation cards represented the solution of a mathematical situation independent of the values of the parameters and variables involved, the analytical engine was to have been completely general in regard to algebraic operations.

As in the difference engine, the analytical engine was to print its own results. Further, a mechanism was to have been added for punching numerical results in blank cards for future use. In this way, the engine could compute the tables required and punch its own cards "entirely free from error."[19]

In 1906, H. P. Babbage, son of the philosopher, completed a part of the analytical engine. A table of multiples of π which it computed to 29 significant digits was published as a specimen of its work.[20] Clearly then, Babbage's failure to complete either of his projects himself was not due to a lack of understanding of the principles and purposes of the engines that he designed, but rather to his lack of machine tools, materials of construc-

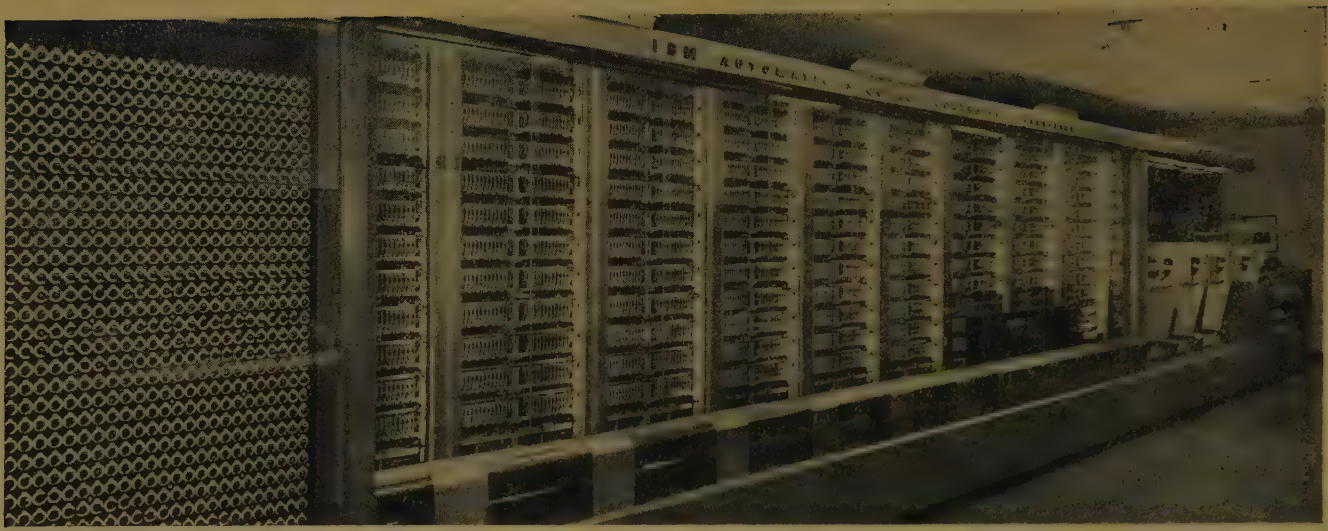

Figure 2. Front view of calculator

Left—Adding storage registers
Center—Multiply-divide counter
Right—Typewriters

tion, and electrical circuits. Though his principles were theoretically sound, and though he was successful to a limited extent, it remained for the 20th century and the evolution of advanced mechanical and electrical engineering to bring his ideas into being.

INCREASED NEED FOR MECHANICAL COMPUTATION

It already has been indicated that the need for mechanical assistance in computation has been felt from the beginning of science. At the present time this need is even greater than before. The intensive development of mathematical and physical sciences in recent years has included the definition of many new and useful functions, nearly all of which are defined by infinite series or other infinite processes. Most of these are tabulated inadequately and their application to scientific problems is retarded thereby.

The increased accuracy of physical measurement has made necessary more accurate computation. Many of the most recent scientific developments are based on nonlinear effects. All too often the differential equations designed to represent these physical phenomena may be solved only by numerical integration. This method involves an enormous amount of computational labor. Many of the computational difficulties with which the physical and mathematical sciences are faced can be removed by the use of suitable automatic calculating machinery.

The development of numerical analysis (a bibliography may be found in the *Annals* of the Computation Laboratory, Harvard University),[21] including the techniques of numerical differentiation and integration, and methods for solving ordinary and partial differential equations have reduced, in effect, the processes of mathematical analysis to selected sequences of the five fundamental operations of arithmetic: addition, subtraction, multiplication, division, and reference to tables of previously computed results. The automatic sequence controlled calculator was designed to carry out any selected sequence of these operations under completely automatic control.

In 1937, the calculator was visualized as a switchboard on which were to be mounted various pieces of calculating machine apparatus, each panel of the machine being given over to definite mathematical operations. The completed machine, 51 feet long and 8 feet high (Figures 2 and 3) closely resembles the original description. It operates normally on 23 significant digits, but high accuracy computations have been carried to 46 significant digits. An automatic sequence mechanism governs the operation of the entire calculator which consists of 60 constant registers, 72 adding-storage registers, a central multiplying and dividing unit, and electromechanical tables of the elementary transcendental functions, $\log_{10} x$, 10^x, and $\sin x$. In addition, three interpolator units, reading functions coded in perforated paper tapes, perform interpolation of any order up to and including the 11th. Computed results may be recorded in tabulating machine cards for the interchange of data from one computation laboratory to another, or for use in further computation. Results also may be printed by means of two electric typewriters. All computations carried out by the calculator are checked automatically before the results are printed in final form.

The sequence and interpolator mechanisms and the counter wheels all are driven and synchronized by a single gear-connected mechanical system. In Figure 4, *A* is a line shaft extending nearly the full length of the calculator. It is driven by the 5-horsepower motor, *B*. This shaft is contained in the shaft housing shown near the base of the machine in Figures 2 and 3. The main sequence mechanism and the three interpolator mechanisms are supplied with mechanical power by roller chain and sprocket drives, *C* and *D* respectively. The spiral gears, *E*, connect the main drive shaft to the vertical shafts, *F*. These in turn are connected to the horizontal shafts, *G*, through small spiral gears, *H*. On the shaft, *G*, are mounted 12 or fewer gear wheels (*J* of Figure 4) each of which supplies mechanical power to a single counter wheel by engaging with the gear shown in the partially assembled counter.

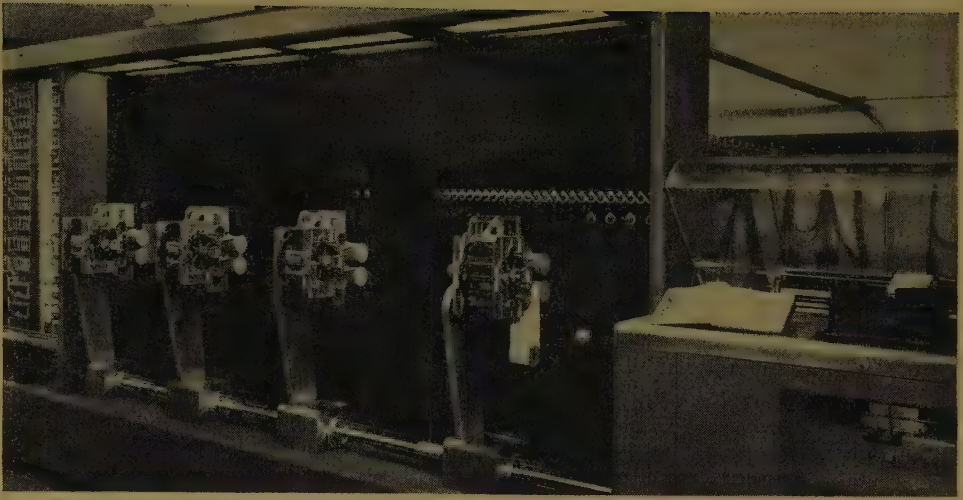

Figure 3. Front view of calculator showing sequence control mechanism (right of four black panels), heart of control, which tells machine what to do and when to do it

At extreme right are recording typewriters, card feeds, and card punch

Each counter wheel is an electromechanical assembly consisting of the following major components:

1. A stationary commutator mounted in a molded plastic part, commonly called a "molding," having a half slip ring and ten segmental contacts numbered 0 through 9.
2. A pair of stranded wire brushes, which rotate to connect one of the contact segments with the commutator half slip ring.
3. A magnetically controlled clutch, which engages to connect the continuously rotating gear with the sleeve on which the rotating brushes are mounted.
4. A ten's carry contact which operates in conjunction with an external relay circuit to provide carry to the counter wheel in the next higher columnar position when the counter wheel under consideration passes through ten.
5. A nine's carry contact which also operates in conjunction with an external relay circuit to provide carry to the next higher counter wheel when the wheel under consideration stands on nine and the next lower wheel has passed through ten.
6. Finally, a socket by which the counter assembly may be jack-connected to the calculator wiring.

The ten segments of the commutator usually are called the number "spots." The time interval necessary for the brush to traverse the distance between two successive spots is 1/16 of a cycle, the number spots being so spaced in the commutator as to minimize the ratio of the mechanical backlash to the distance traversed between spots. In order to read, for example, a seven into a counter, the counter magnet is picked up at "seven time," thus engaging the clutch. The brushes are spun past six spots and the clutch is disengaged mechanically or knocked off at "zero time." Obviously, nine equally timed and equally spaced impulses must be provided to pick up the counter magnets in order to read in the nine digits and all counters must be knocked off at zero time.

The number impulses are supplied by cam-controlled contacts. The position in which the cams are mounted is shown in Figure 4, *K*. The duration of the contact controlled by a cam may be varied by adding or subtracting rollers in the 20 possible sockets in a cam wheel. Several types of followers are used, with variations in the sharpness of the make and break of the contacts they control.

For purposes of cam timing, the fundamental cycle of the calculator, 300 milliseconds, is subdivided into 16 equal parts commonly referred to as "points." The first nine subdivisions contain the number impulses. The so-called "seven impulse," for example, is delivered by a cam contact making at seven time and breaking half way between seven and six time, commonly called $7^1/_2$ time. The points zero through 16 are available to supply carry and other control impulses.

The transfer of a quantity to a reset, or cleared, counter and the process of addition are the same. For instance, a counter stands at zero, a seven impulse picks up the counter magnet at seven time, the counter wheel rotates through six positions, is knocked off mechanically at zero time, and comes to rest standing on the seven spot. On the other hand, if a counter stands at five, a seven impulse picks up the counter magnet at seven time, the counter wheel rotates through six positions, is knocked off mechanically at zero time, and comes to rest standing on the two spot, having passed through zero.

As the counter wheel turns, the carry cam also turns. When the rotating brush touches the nine spot, the follower of the carry cam is dropped and the nine's carry contact is made. As the counter wheel passes nine and approaches the zero spot, the follower is raised and the ten's carry contact is made. The ten's carry contact once made is maintained until a mechanical knockoff returns the carry contact to neutral position at $14^1/_2$ time. The counter magnet again is picked up at 12 time by the carry impulse if the carry relay circuits are closed and if the ten's carry contact of the next lower counter is made. The counter magnet also is picked up at 12 time by the carry impulse if the carry relay circuits are closed and if the nine's carry contacts of the succeeding lower counters receive a carry impulse due to a still lower ten's carry. The counter wheel moves one position for the carry and again is knocked off mechanically at 13 time.

The relays in the calculator are of a standard type of which six varieties are employed, 4, 6, and 12 pole, double throw, single or double coil. When a double coil relay is used, one coil serves for pickup, the other for hold. When it is required that more than 12 poles operate simultaneously, a number of relays are wired in parallel as a "bank."

THE SEQUENCE CONTROL UNIT

The sequence control unit, shown in Figure 5, consists of a main drive sprocket drum over which runs a perforated paper tape, called a control tape, together with such gears, cams, and clutches as are necessary to advance the drum and tape one line of perforations at a time. The sequence unit is equipped with a set of 24 sensing pins, controlled by a crosshead, which are advanced at the end of each forward step of the tape to detect the distribution of holes in one line of the tape and to close electrical contacts in the same distribution.

Each horizontal line of the tape has space for 24 equidistant holes which are considered as three groups of eight holes each, known as the *A*, *B*, and *C* groups. The *A* group of holes controls the "out-relays" by means of which all units in the machine are connected to the central distribution bus over which numbers are transferred from one unit to another with the aid of the number impulses. The *B* group of holes controls the "in-relays" of all of the units in the machine. These also connect the units to the central distribution bus, and, when closed, permit the egress of numbers from the bus into the units. Finally, the *C* group of holes represents, in general, an operation to be performed on the number in unit *A* in connection with the number in unit *B*.

Each horizontal line of holes perforated in the tape is the equivalent of a single spoken command, "Take the number out of unit *A;* deliver it to unit *B;* start operation *C.*" Since the *A*, *B*, and *C* groups of perforations each contain eight holes, the maximum number of out, in, or operational relays which can be controlled by the machine is $2^8 = 256$ each. The maximum possible number of commands which can be represented by a single line of holes is $2^{24} = (256)^3 = 16{,}777{,}216$. The number of combinations of coded perforations in use at present is considerably smaller than the maximum possible number. However, the number of consecutive lines of holes in no way is limited and it is apparent that control tapes may be provided with great generality. The reiteration of the single command, "Take the number out of unit *A;* deliver it to unit *B;* start operation *C,*" permuting *A* and *B* over the various units of the machine while changing the nature of the operation *C*, is sufficient to guide the machine through any mathematical problem capable of being reduced to the five fundamental operations of numerical analysis.

At the left of the machine, as well as at the left of Figure 6, are the 60 constant registers. Each constant register consists of 24 manually set 10-pole dial switches designed to accommodate 23 digits and the algebraic sign. Because of their composition, the constant registers are known as the 60 "switches." Each constant register or switch is connected to the bus through its out-relay, and each is connected to the common transfer terminal of the storage register invert relay. The normally closed and normally open contacts of this relay are connected in turn to the direct and invert cam-controlled contacts, respectively, which furnish the timed electric impulses necessary to the transfer of numbers by way of the bus.

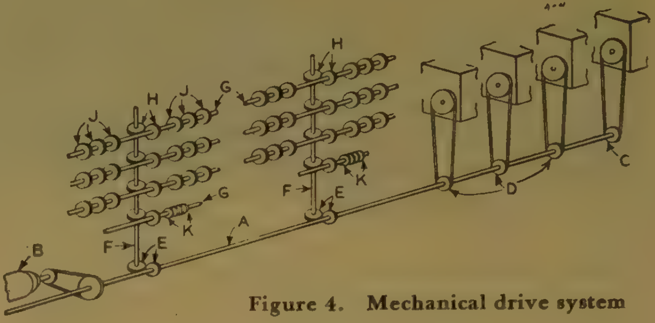

Figure 4. Mechanical drive system

To the right of the switches, Figure 6, are shown diagrammatically the 72 storage registers. Each storage register consists of 24 electromechanical counter wheels. The storage registers, usually referred to as "storage counters" or more briefly as "counters," have electrical circuits similar to those of the switches. In addition, each storage counter is provided with an in-relay connected to the bus, a complete set of carry controls, and a connection to the negative terminal of the generator.

Each register in the calculator is provided with a code number corresponding to the numbers of the holes perforated in the tape. The code numbers of the storage counters, 1, 2, 3, . . ., 71, 72, which may appear in either the *A* or the *B* column, are 1, 2, 21. . . ., 7321, 74, respectively, while the code numbers of the switches, 1, 2, 3, . . ., 59, 60, which may appear in the *A* column only, are 741, 742, 7421, . . ., 821, 83, respectively. Similarly, all operations in the calculator have assigned code numbers. For example, code 32 in the *C* group of perforations controls the storage counter invert relay, and hence is the mathematical equivalent of a minus sign.

Now let it be required that the number x in storage counter 3, code 21, be added to the number y in storage counter 71, code 7321. This requires that holes 2 and 1

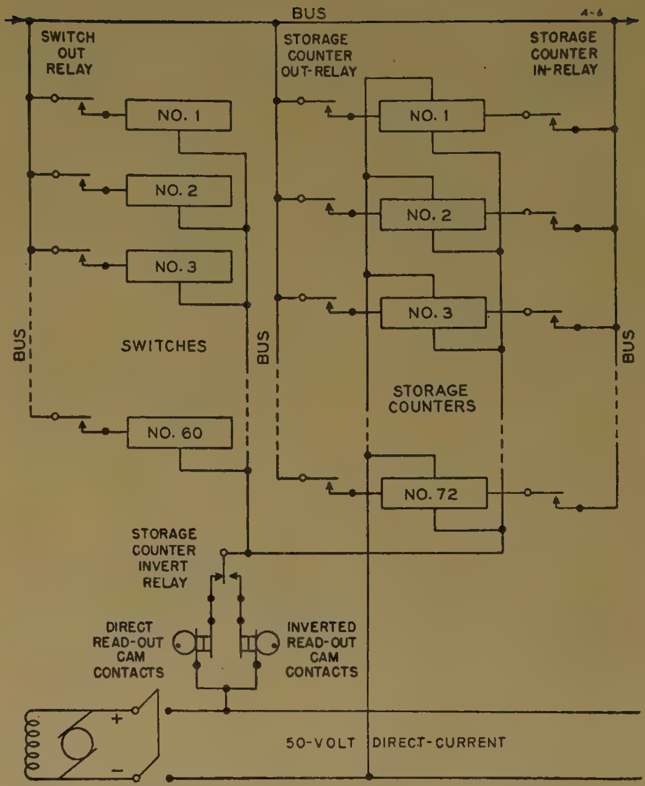

Figure 6. Switches and storage counters

be punched in the *A* column and holes 7, 3, 2, and 1 in the *B* column. The line of coding thus may be written (21, 7321, blank). On the other hand, if it is required that x be subtracted from y, the line of coding will be written (21, 7321, 32), indicating that by means of the invert relay the nines complement of the quantity x in counter 3 is to be added into counter 71.

Referring again to Figure 6, the perforations in the control tape corresponding to code 21 in the *A* column, as interpreted by the sequence mechanism, cause the closure of the out-relay of counter 3, while the code 7321 in the *B* column causes the closure of the in-relay of counter 71. The blank in the *C* column of the coding is interpreted as a plus sign leaving the storage counter invert relay in its normally closed position. A complete electrical circuit exists beginning at the positive terminal of the generator, passing through the cam contacts, through the normally closed contacts of the storage counter invert relay into counter 3, through counter 3 and its out-relay to the bus, from the bus to counter 71 through its in-relay, through counter 71, and finally back to the negative terminal of the generator. Thus, the number impulses produced by the cam contacts are able to transfer the quantity in counter 3 to counter 71 and bring about addition.

When it is necessary to subtract x from y, the whole operation is the same except that code 32 in the *C* column causes the storage counter invert relay to transfer its contacts. This causes the complement on nine of x to be read out into the bus instead of x itself. As all storage counters are equipped with complete carry controls, including end around carry, addition of the complement on nine completes the process of subtraction as demanded in the example.

Before further considering the functions of the storage counters, it is necessary to discuss briefly the means by which the calculator is kept in continuous operation. Most mechanisms, once started, remain in operation until signaled to stop. By contrast, the calculator continues in operation only as long as the command "continue operation" is repeated, cycle by cycle, and immediately stops when this command is not given. A 7 in the *C* column of a line of coding instructs the sequence mechanism to continue operation; that is, to read the next line, act upon it, and step to the line beyond. Every line of coding must contain a 7 in the *C* column or its equivalent in the form of some other automatic continue operation code. As the storage counter codes are not such "automatic codes," the two examples of coding already cited should read: take x from counter 3 and add it to y in counter 71 (21, 7321, 7); take x from counter 3 and subtract it from y in counter 71 (21, 7321, 732).

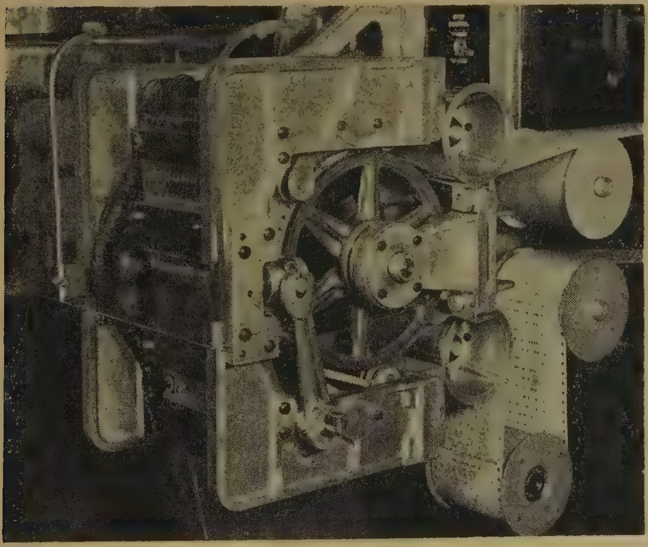

Figure 5. Closeup view of sequence control mechanism

THE STORAGE COUNTERS

From what has been discussed thus far it should be clear that storage counters serve more than one purpose. Each is a complete adding and subtracting machine, and functions as a storage or memory device, thereby providing the calculator with brackets, parentheses, and other signs of association as required in mathematical expressions. In addition, relays associated with each counter provide other functions not indicated in the single line diagram, Figure 6, for purposes of clarity.

The quantity in each storage counter may be read out as either a positive or negative absolute value under the control of the operational codes 2 and 1, respectively, in the *C* column of the line of coding. For example, if x lies in storage counter number 23, code 5321, and y in counter number 34, code 62, then $|x|+y$ may be obtained in counter number 34 by the line of coding: add $|x|$ to y (5321, 62, 72). The use of absolute magnitudes provides the calculator with a means of dealing with discontinuous functions. For example:

$$y=(x+|x|)/2x=0 \text{ or } 1$$

according to whether x is negative or positive. Clearly y, as defined here, represents a Heaviside unit function.

Each storage counter may be reset to zero by reading into the counter the complement on ten of the quantity standing in the counter while the carry controls are disabled. This is accomplished for any storage counter whose code is *A* by the line of coding: reset counter *A* (*A*, *A*, 7). Inasmuch as a blank other than 7 in the *C* column of coding has been defined as a plus sign, the reset coding requires further explanation. The resetting operation is one which occurs with great frequency. To eliminate the necessity of writing and rewriting a special reset code in the *C* column, a reset relay is included in the machine which is picked up by the duplication of a storage counter code in both the *A* and *B* columns of a line of coding. The reset relay provides the complements on ten to reset the counter concerned.

Of all the computing elements in the calculator, the storage counters are the simplest. It is relatively easy to alter and to add to their electrical circuits in a way which will not interfere with their normal functioning but, at the same time, will introduce added possible operations. A number of such special operations have been required in the past and were built into the machine permanently.

Counter 70 has been equipped with relay circuits which prefix the algebraic sign of the quantity in counter 70 to the positive absolute value of the quantity standing in any other storage counter when the latter is read out under code 432 in the *C* column. This feature is especially valuable when dealing with the interpolation of odd functions, since it is only necessary to evaluate $f(x)$ in order to have available $f(-x) = -f(x)$.

Associated with counter 71, the "multiple in–out" counter, is a special set of carry controls which make a 12-column storage register out of the 12 high order columns of the counter. This 12-column counter is complete with end around carry, can be reset independently, and does not interfere in any way with the normal 24-column functioning of counter 71. The multiple in–out counter has extra in and out relays which connect the upper 12 columns of the counter to either the upper or the lower 12 columns of the bus. Mathematically, this is the equivalent of multiplying by 1 or 10^{12} when numbers are read into the counter and by 1 or 10^{-12} when numbers are read out of the counter, depending upon the codes employed. In all problems requiring less than 12 significant digits for computation, the transfer of numbers through counter 71 permits the storage of two quantities in each of the 72 storage counters, thus doubling the storage capacity of the machine. The function of the multiple in–out counter is most valuable in statistical computation where the quantities dealt with are large in number and of low accuracy.

THE "GANGED COUNTERS"

Just as the multiple in–out counter doubles the storage capacity of the calculator at the expense of accuracy, the "ganged counters," 68 and 69, double the accuracy of the machine at the expense of storage capacity. Counters 68 and 69 are equipped with special carry controls so that they function as a single storage register consisting of 46 columns and the algebraic sign which is repeated in the two component counters. As this feature has proved to be of considerable value in high accuracy computation, particularly in the computation of the Bessel functions, counters 64 and 65 likewise have been ganged together. Needless to say, the inclusion of the special carry controls on counters 64, 65, 68, and 69 do not interfere with their normal functions. Two lines of coding are required to make a single 46 column addition, since the two parts of the number must be added successively. An 8 prefixed to the ordinary read-in codes of the ganged counters picks up the special carry controls. The addition of $A+B$, a 46-column quantity lying in counters 35 and 34, codes 621 and 62, to $C+D$, standing in counters 69 and 68, codes 731 and 73, is coded as: add $A+B$ to $C+D$ with special carry controls (621, 8731, 7), (62, 873, 7).

The most important of the specialized storage registers is the automatic check counter, 72. In general, all checks may be reduced to determining that a given quantity, c, is less in absolute magnitude than a selected positive tolerance, t; that is, that $t-|c|>0$. The use of the check counter is based upon the notion that this inequality will be evaluated in counter 72. Obviously, an end around carry will occur when $-|c|$ is added to t, if, and only if, the inequality holds. The coding for the check procedure is: check the quantity in counter *C* against the positive tolerance in switch or counter *T* (*T*, 74, 7), (*C*, 74, 71), (blank, blank, 64), where code 64 is an automatic continue operation code if, and only if, an end around carry takes place in the check counter. If $t-|c|\leq 0$, no end around carry will take place, the machine will receive no command to continue operation and so will stop.

Parts II and III of this article will appear in subsequent issues.

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Quality Reports for Management

MARTIN A. BRUMBAUGH

War experience brought to the fore the desirability of statistical quality control and today an increasing number of industrial concerns are utilizing this method of improving the processes of manufacture. However, many firms, notably smaller establishments, still are not employing quality reports when they could do so to advantage. This article emphasizes the necessity of making management quality-control conscious and cites actual cases to prove its point.

THIS SUBJECT presupposes that a quality control operator has been at work in a plant and has obtained some results that are worth reporting. In making such a report he must recognize that there exists a great variety of:

1. Types of plant operations.
2. Points of view of quality control operators.
3. Attitudes of management.

Each of these factors must be taken into account in planning a reporting program. Accordingly what follows here must be interpreted in terms of conditions existing in a particular plant. In general, a quality control operator earns his salary by possessing two types of ability: a knowledge of where to find things in a book, and a knowledge of when to abandon the book in favor of his own ingenuity.

The operator who is in the fortunate position of working with management that understands the technique of statistical control can report in detail everything that he is doing. In fact, keeping management fully informed is the best method of maintaining interest in the work.

The author has witnessed the successful use of the following three entirely different methods of reporting to a management that was uninformed on statistical control. There must be others that have been used with equal success.

1. The probability approach: set up examples with cards, dice, or colored beads to show chance variability; plan the experiments so that they will be applicable to the plant's manufacturing operations.

2. The control chart approach: tell the story of separating chance variability from assignable causes of variability; show the frequency distribution analysis and application to plant operations; present the principles of sampling, preferably with examples of potential or actual savings.

3. The indirect approach: forget statistical control and tell the story solely in terms of operations and results obtained; bring in the control chart as an operating device and keep the statistical background out of the presentation.

If management is hostile, or even only lukewarm, great care is required. In the belief that this situation requires the greatest amount of discussion, two cases are presented in the sequel in which quality control operators succeeded in converting hostile managements.

CASE I

The quality control engineer operated two levels below the quality manager who reported directly to the plant superintendent, the responsible policy-making

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Essential substance of a conference paper presented at the AIEE winter convention New York, N. Y., January 21–25, 1946.

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executive. Initially the quality control engineer was authorized by his supervisor to analyze records of inspection of assembly operations. The engineer prepared charts of number of defects per unit and posted them at all assembly stations. Simultaneously he inaugurated a system of weekly reports. These reports were circulated to foremen of inspection and production as well as to the quality manager and the plant superintendent. There was no evidence that the executive paid the slightest attention, but the quality of assembly work improved steadily.

At the end of three months the engineer submitted a report which included Table I. This table finally attracted the plant superintendent's attention and he ordered an expansion of the statistical department with instructions to investigate fabrication operations and receiving inspection.

The machine shop, although producing 400,000 piece parts per week, was characterized by short runs, sometimes making as many as 800 different part numbers in one week. Control chart analysis of an operation of this type was not attempted, even though the initial record of 15 per cent reworked and 4 per cent scrapped indicated plenty of room for improvement. Instead, a weekly report of the form shown in Table II was circulated to management and to shop supervision. Just as in the assembly area, this report received scant attention and for several weeks no improvement was shown. A chronic rework was defined as an item for which at least 10 per cent of production was returned to the machine shop for at least three successive weeks. This supplementary information finally caught the eye of the plant superintendent and action followed quickly. Individual foremen were called in for specific explanations. The usual attempt to "pass-the-buck" was stopped short by the detailed inspection records presented by the control engineer. Corrective action was swift and permanent. The results after seven months of reporting are apparent in Tables II and III.

Table I. Man-Hours Per Unit in Assembly Before and After Using Statistical Control

Item	November December January (Man-Hours Per unit)	February March April (Man-Hours Per unit)
Assembly	3,240	3,328
Inspection	733	766
Repair and replacement	1,209	405
Reinspection	290	56
Total	5,472	4,555
Number of units accepted by United States Army	367	508

A report to the plant superintendent stressed the fact that in 1944 one piece out of six passing through the shop and passing to the inspection bench was covering the route a second time. Stated differently, this meant that one-sixth of the machine capacity of the shop was ineffective and that inspection costs were inflated by 20 per cent. This situation was corrected automatically by the reduction in reworks in 1945 This report was made to offset the shop supervision contention that reworks were inexpensive.

Table II. Quality of Production in Machine Shop Before and After Corrective Action

Status	Number of Pieces Through Inspection Week Ending		Per Cent of Total Pieces Inspected Week Ending		Average Per Cent for Previous Ten Weeks Week Ending	
	August 19, 1944	March 24, 1945	August 19,1944	March 24,1945	August 19,1944	March 24,1945
Accepted as is	332,518	218,706	83.7	97.1	85.2	97.5
Not accepted as is	64,757	6,474	16.3	2.9	14.8	2.5
Total	397,275	225,180				

A parallel reporting procedure was set up for receiving inspection, but its effect was negligible until the control engineer prepared a vendor rating sheet and submitted it to the purchasing department. This sheet is shown as Table IV, with individual part numbers and vendors listed. The first one was made for a list of standard parts. Subsequent ones were made for the list of special parts going into a single subassembly. Purchasing discovered the parts for which a particular vendor could maintain good quality, as well as the vendor or vendors that could maintain good quality on a particular part number. A supplementary sheet showing the number of rejected lots during the month returned to each vendor, quickly revealed the source of most of the costly follow-up work of the purchasing department. On the basis of this rating sheet the purchasing department rearranged its contracts, assigning to each vendor the part numbers which that vendor could do best. A few vendors with uniformly poor quality records were dropped. The effect of this rearrangement was apparent on the rating sheets of subsequent months.

The reports described are only a sample of the work done by this control engineer. He adhered to the point

Table III. Analysis of Rejected Pieces

From Table II

Reason for Return to Machine Shop	Number of Pieces Week Ending		Per Cent of Total Pieces Inspected Week Ending	
	August 19, 1944	March 24, 1945	August 19, 1944	March 24 1945
Operations omitted	23,320	712	5.62	0.32
Rework dimensions	15,338	1,562	3.86	0.69
Burrs	10,159	46	2.53	0.02
Rechase threads	8,311	132	2.09	0.06
Strip chrome	1,182	496	0.30	0.22
Heat treat	1,343	18	0.34	0.01
Miscellaneous	714	538	0.18	0.24
Scrapped	15,230	2,998	3.83	1.33
Total	75,597*	6,502*		

* Higher total due to multiple defects.

Table IV. Vendor Rating Sheet

Average Per Cent Defective of Inspected Samples or Lots

Name of Vendor	Part Number 1	2	3	4	5	6
A		0.02		0.02	0	
B						0.05
C	0.08	0	0.03			0.01
D				0.11		0
E			0.03	0.04		
F		0.10		0.07		

of view that corrective action should be the responsibility of production, but that it was his task to provide as much detailed information as possible to aid production. He made no spectacular attempts to attract the attention of top management, but rather depended upon the cumulative effect of repetitive reporting. He did come to three conclusions:

1. Immediate superiors with no knowledge of quality control procedure and no desire to acquire such knowledge are a hindrance to progress despite good intentions.

2. Top management must possess some knowledge of quality control procedure and a genuine interest in using control results as a management tool, if the work of the control engineer is to be effective.

3. There is no method of evaluating or reporting the intangible gains from the use of statistical control; hence evaluated dollar savings are always an underestimate of the benefits of a control system.

CASE II

The chief inspector of this plant reported directly to the factory manager and within his own function possessed sufficient authority to introduce statistical control procedure as an integral part of inspection operations. This was done initially in the assembly area because this plant does comparatively little fabrication, although many special parts are machined in the plant.

Over a span of three months considerable improvement in assembly operations resulted from daily and weekly reporting of the results of inspection. When out-of-control conditions were encountered, immediate investigation followed. In some cases this led directly to receiving inspection. Detection of quality variation there led in several cases to the dispatch of trouble shooters to plants of vendors. In other cases assembly failures quickly were traceable to faulty machine shop operations. In still other cases it was found that piece parts and subassemblies were being damaged during assembly. In a few cases blueprints were changed on the basis of the control chart records. Corrective action produced results which were recognized by operating supervision throughout the plant, but top management gave no evidence of being aware of the existence of the quality control system until the chief inspector prepared a summary in the form shown in Table V.

Table V. Status of Assembly Operations After Three Months of Corrective Action Based on Control Chart Records

Assembly Operation	Per Cent Defective: At Start of Program	One Month Later	Two Months Later	Three Months Later	Per Cent Improvement in Three Months
A	6.2	5.1	4.1	2.3	63
B	36.0	22.9	13.5	10.4	71
C	11.2	6.6	4.9	1.7	85
D	10.7	8.2	3.4	2.5	77
E	69.6	65.8	61.5	45.8	34
F	18.8	12.3	11.3	10.6	44
G	6.3	4.2	2.6	1.5	76
H	7.2	5.1	3.9	2.9	60
I	15.3	9.7	5.2	4.6	70
J	10.1	3.5	2.7	1.6	84
K	26.9	16.1	12.7	9.1	66
L	2.7	1.1	0.3	0.4	85

This report produced ample response from top management, and the chief inspector was authorized to install statistical control of all operations in the plant. The chief inspector is very meticulous about placing on the president's desk periodic summary reports of the quality status of all operations.

In passing, several other experiences can be mentioned briefly. A quality manager planning the introduction of statistical control "sold" the idea to top management and secured a general directive authorizing him to install his system. He then began issuing orders to operating departments, but did not train men in his own inspection department in control chart technique or corrective action procedure. Needless to add that the results were disastrous. This man shortly was transferred to another plant and soon left the company.

In another plant a new vice-president in charge of plant operations announced that all emphasis must be placed on two departments—production and selling. Pursuant of this plan, the inspection department was skeletonized and a flourishing statistical control installation was abandoned. Three months of this policy resulted in the loss of a long-standing contract to make an important subassembly for a large automobile manufacturer.

SUMMARY

Because conditions vary so greatly from plant to plant, there is little possibility that any usable rules can be stated for reporting quality control results to management. The following, which are little better than guesses, may have some guidance value:

1. Present summaries, not details.

2. Make it simple, but be sure to tell the story.

3. Dollar savings are most effective, but dollar figures often breed controversy. Perhaps a man-hour report will serve better than a dollar report.

4. Modesty is essential, over-modesty may be fatal.

5. No harm will come from allowing a small amount of residual mystery to inhere in the expression, "statistical control."

6. Concrete results will attract attention; do not waste an executive's time with reports of pious hopes.

INSTITUTE ACTIVITIES

Some Jobs to Be Done—*A Message From the President*

As a matter to which some special attention should be given during the 63rd year of our AIEE activities, I wish to bring to your attention the problem of the industrial electrical engineer, a problem with which I have been struggling for some 30 years. The Institute has done a great deal for the industrial electrical engineer, but our field of industrial activity has expanded so greatly that we now need to make special efforts to cover that field adequately. Rather than to default in our opportunity, and allow the industrial electrical engineers to branch out into a separate organization, as others have done in the past, let us *do* something *now* to serve the needs of this particular group. The AIEE local Sections are in the best position to do something about this matter. They are close to the industrial areas, and I believe that they could determine very readily the peculiar problems, needs, and interests of the industrial groups.

Particularly, aside from the purely technical phases of the problem, I should like to emphasize the desirability of getting together and rubbing elbows with the industrial engineers. Too many of us are inclined to think that this group has been graduated too recently from the screwdriver-and-pliers class to deserve much attention. Quite to the contrary, the complexity of the apparatus and circuit for which industrial engineers are responsible, demands considerable talent, even from the research and scientific fields.

I urge the Sections committee to encourage meetings between the power systems engineers and the engineers in industrial plants. In the textile mills of the South, some progress has been made in this very direction, and the common contact has been found to be mutually beneficial. It should be extended. In the more densely settled industrial areas, such meetings already have been established. Where the territory is spread thin, and one AIEE Section covers an entire state, it may be possible for these Sections to arrange for speakers to travel to some of the smaller industrial towns, and there put on programs of industrial interest. I believe that this would be beneficial, even though the initial attendance at such meetings might be relatively small. Perhaps the Sections committee might do well to study the use of wire sound recorders and transcriptions, and radio programs or film, such as the sales departments of various companies have used so effectively.

Another example of what I have in mind is represented by the special report, "Electric Power Distribution for Industrial Plants," developed by our committee on industrial power applications. I believe that this excellent report should be called to the attention of a large number of the key industrial engineers who are not members of the Institute, as a means of introducing them to AIEE activities. The industrial field is wide open, and the surface has not yet been scratched so far as membership possibilities are concerned; continued industrial expansion gives us an opportunity to share AIEE benefits with the engineers of industrial plants.

Another opportunity for intimate contact and discussion of common problems with industrial engineers lies in the technical groups that have been developed by many of our Sections, and which are so deservedly popular. I hope that this idea will continue to expand. Particularly, I consider it to be especially desirable that more industrial groups such as electronics, instruments and measurements, and perhaps refresher courses in industrial or other technical subjects, be established and actively operated by our Sections.

Especially do I urge our Sections to undertake to bring research men and manufacturing engineers closer together on a basis of common understanding; to establish a closer and better working relationship between our Sections and our Student Branches, particularly with reference to the matter of training men specifically for the very important field of industrial plant operation; to establish study and discussion groups on economic problems, and on employer–employee relations as they involve the engineer; to extend the range of Section co-operative efforts with other engineering groups and local councils on problems of common interest and contemporary importance; and to promote the growth and development of Subsections, especially in areas with scattered industrial installations.

Without challenging the need of the basic technical data which the AIEE has been accumulating over the years, I believe that it is necessary also to recognize the problems of the user of electric equipment. There are many startling things encountered in the application and operation of equipment, that could not possibly have been anticipated by the designer; discussion of these would be helpful to the designer, the researcher, and the user.

J Elmer Housley

AIEE Pacific Coast Meeting, Seattle, Wash., August 27–30, 1946

Tuesday, August 27

9:00 a.m. Opening Session

C. F. Terrell, presiding

Address: Development of Atomic Power. **Bruce R. Prentice**, General Electric Company

46-178. Power System Development for Service to Hanford Plutonium Plant. **B. V. Hoard, J. R. Curtin**, Bonneville Power Administration

46-185—ACO.* Columbia River Power. **E. I. Pease, H. W. Goodhue**, United States Engineer Office, Seattle

2:00 p.m. Central Stations

Thomas Ingledow, presiding

46-184. Specific Engineering Problems in Rural Electrification and Electroagriculture. **M. M. Samuels**, Rural Electrification Administration

46-201—ACO.* Hydroelectric Power System Design. **S. M. Denton**, United States Department of the Interior, Denver

46-191—ACO.* Design Factors to Promote Reliability of Hydroelectric Station Auxiliaries. **C. L. Killgore**, United States Department of the Interior, Denver

46-177. 4,370,000-Kva Short-Circuit Tests on Grand Coulee 230-Kv Bus. **W. H. Clagett**, United States Bureau of Reclamation; **W. M. Leeds**, Westinghouse Electric Corporation

46-195. The Use of Business Machines in Determining the Distribution of Load and Reactive Components in Power Line Networks. **P. D. Jennings, G. E. Quinan**, Puget Sound Power and Light Company

Wednesday, August 28

9:00 a.m. Industrial and Railroad

W. C. Smith, presiding

46-186. Comparisons of Railway Motive Power for Operation in the Pacific Northwest. **T. M. C. Martin**, Bonneville Power Administration

46-91. High-Voltage Ignitron Rectifiers and Inverters for Railway Service. **J. L. Boyer, C. G. Hagensick**, Westinghouse Electric Corporation

CP.** A New D-C Control for Cargo Handling. **S. Rifkin, W. R. Morton**, General Electric Company

46-179. Fault-Current Measuring Device. **M. J. Lantz**, Bonneville Power Administration

46-187. Teaching Electricity and Magnetism. **V. P. Hessler**, University of Kansas

46-194. Self-Excited Electromagnetic Drive for a Resonant Fatigue Machine. **A. R. Willson**, Boeing Aircraft Company

2:00 p.m. Student Session

E. W. Schilling, presiding

Carrier Current through Power Distribution Networks. **V. Clayton, E. Jones**, University of Utah

Railway Signaling. **F. Curry**, University of Arizona

● PAMPHLET reproductions of authors' manuscripts of the numbered papers listed in the program may be obtained as noted in the following paragraphs.

● ABSTRACTS of most papers appear on pages 411–13 of this issue.

● PRICES and instructions for procuring advance copies of these papers accompany the abstracts. Only numbered papers are available in pamphlet form.

● COUPON books in five-dollar denominations are available for those who may wish this convenient form of remittance.

● THE PAPERS regularly approved by the technical program committee ultimately will be published in "Transactions"; many will appear in "Electrical Engineering."

Operation of an Electronically Controlled D-C Motor. **R. Angell**, University of Idaho

Reconnection of an Induction Motor for Different Speeds. **G. D. Cowles**, University of Southern California

Electronically Controlled Circuit Breaker. **W. R. Aiken**, University of California

Thursday, August 29

9:00 a.m. Aviation

F. F. Evenson, presiding

Address: Military Aviation

46-193. Effects of Thermal Characteristics of Aircraft Generators on Load Analysis. **Stanley Rogers**, Consolidated Vultee Aircraft Corporation

46-190. Electrical Anti-Icing of Aircraft Windshields. **J. D. McCrumm**, Douglas Aircraft Company, Inc.

46-188. An Electronic Meter and Speed Regulator. **Ellis Levin**, Boeing Aircraft Company

46-197. 150,000 Horsepower Applied to Aeronautical Research. **J. A. White**, National Advisory Committee for Aeronautics

46-180. Control and Protection of Aircraft D-C Power Systems. **B. O. Austin**, Westinghouse Electric Corporation

46-192. An Improved Azimuth Indicating System for Aircraft. **E. E. Lynch, R. A. Pfuntner**, General Electric Company

2:00 p.m. Power Systems

E. A. Loew, presiding

46-189. Dielectric Strength of Station and Line Insulation to Switching Surges. **P. L. Bellaschi, L. B. Rademacher**, Westinghouse Electric Corporation

46-182. Long-Distance Power Transmission As Influenced by Excitation Systems. **C. Concordia, S. B. Crary, F. J. Maginniss**, General Electric Company

46-181. An Oscillograph for Recording Transient Recovery Voltages. **W. G. Hoover**, Stanford University

46-200. Sensitive Ground Relay Protection for Complex Distribution Circuits. **L. F. Hunt**, Southern California Edison Company, Inc.

46-196. Characteristics of a 400-Mile 230-Kv Series-Capacitor-Compensated Transmission System. **B. V. Hoard**, Bonneville Power Administration

Friday, August 30

9:00 a.m. Discussion on Organization of the Engineering Profession

C. B. Carpenter and **J. F. Fairman**, presiding

As has been done in other sections of the country, this session has been arranged to afford members in the Pacific Coast region an opportunity to participate in a discussion of the several projects under consideration by the Institute's committee on planning and co-ordination. It is hoped that members who plan to attend will review and discuss among themselves in advance the information about the activities of the committee on planning and co-ordination, which has been published in recent issues of *Electrical Engineering*. In particular, a lively discussion from the floor is anticipated about the respective merits of the four plans of organization of the engineering profession, outlined in the progress report of the professional activities subcommittee, which appeared in *Electrical Engineering*, April 1946, pages 169–73. The views of a representative cross section of the members in the Pacific Coast region about these important matters will be most helpful to the committee in its work.

2:00 p.m. Communications

F. O. McMillan, presiding

46-198—ACO.* Television—A Review of Present Status. **E. W. Engstrom, R. D. Kell**, Radio Corporation of America

46-183. Application of Compandors to Telephone Circuits. **C. W. Carter, Jr., A. C. Dickieson, D. Mitchell**, Bell Telephone Laboratories, Inc.

46-199. Field Tests of Power Line Carrier Current Equipment. **R. H. Miller**, Pacific Gas and Electric Company; **E. S. Prud'homme**, General Electric Company

CP.** Four-Tone Dual Channel Carrier Shift Telegraph System. **F. J. Werthmann**, Werthmann Radio Company

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*ACO: Advance copies only available; not intended for publication in *Transactions.*

**CP: Conference paper, no advance copies are available; not intended for publication in *Transactions.*

Summer Convention Held in Detroit for Third Time

With a verified registration totaling 1,351, the 61st annual summer convention of the AIEE set a new record for recent years, exceeded only by the 1923 summer convention at Swampscott, Mass., for which the reported registration was 1,616. The 1946 convention was held in Detroit, Mich., June 24–28, inclusive, with headquarters at the Hotel Statler. A heavy program of meetings, technical sessions, and conferences kept the members too busy to take full advantage of the recreational and inspection trip features arranged by the local committee. A continuous program of special events arranged by the local women's committee occupied the many women guests of the convention all week.

The formal program provided 19 technical sessions, 7 technical conferences, 8 administrative conferences, and 23 committee meetings, in addition to which several groups met impromptu for the discussion of special problems. The program provided for the presentation and discussion of some 75 technical program papers, 25 informal conference papers or presentations, and a huge number of special conference topics. The heavy and rigorous program evoked considerable casual comment, some approving a full and diversified program as a means of better service and appeal to a wider range of members, some urging strongly that, at least for the summer conventions, most of the formal meetings should be confined to morning schedules, leaving afternoons open for inspection trips, recreation, and other special features.

All of the technical sessions and most of the meetings and conferences were held in the headquarters hotel, but some of the administrative conferences and many of the committee meetings were accommodated at other hotels, the Rackham Memorial headquarters of the Engineering Society of Detroit, the offices of the Michigan Bell Telephone Company, and the offices of the Detroit Edison Company.

ANNUAL BUSINESS MEETING

The official annual business meeting of the Institute was called to order at 10 o'clock Wednesday morning, June 26, 1946, in the Wayne Room of the Hotel Statler, Detroit, by President W. E. Wickenden (F '39).

SECRETARY ABSTRACTS BOARD REPORT

Secretary H. H. Henline (F '43) invited the special attention of delegates and members to the detailed annual report of the board of directors, which was distributed at the meeting in pamphlet form and which was published in full in *Electrical Engineering* for July (*pp 331–50*). Special mention was made of the large number of Section visits made by President Wickenden, the active resumption of District meetings and conventions following the close of the war, and to the vitality and extended nature of Section activity; as well as to the important work of the technical program committee, the publication committee, the committee on planning and co-ordination, and other general and technical committees. These subjects are covered in the board report.

Mr. Henline reported that: "Membership had grown by April 30, 1946, to 25,090 . . . by June 2, to 25,218 . . . a net gain for the past fiscal year of 2,018, the largest for any year in the history of the Institute." He reported that Student Branch activities were being reactivated rapidly, following a severe wartime shrinkage; that "before the war, about 50 per cent of the applicants for Institute membership were the student members coming in as Associates; in recent war years that percentage fell to about 11."

As indicative of the extent to which opportunities for more active participation are being brought within the convenient reach of more members, Secretary Henline reported that 1,187 Section meetings were held during the fiscal year just closed, as compared with 747 for the preceding year; that the average number of meetings per Section had increased to 15.8 per year; the number of Section technical groups jumped from 155 to 195; and the number of Subsections from 12 to 20.

TREASURER SUMMARIZES FINANCES

Treasurer Walter I. Slichter (F '12) summarized as follows the financial statement included in the board report, covering the fiscal year ended April 30, 1946:

	1945–46	**1944–45**
Receipts for the year	*$537,476.29	$468,098.86
Out of pocket expenditures	395,978.86	374,373.19
Gain for year	141,497.43	93,725.67
Investments	125,084.27	66,600.49
Net cash gain	16,413.16	27,125.18
Assets		
Book value of all reserves	$483,572.94	$359,259.96
Accrued interest	89.75	89.75
Cash in reserve fund	47,304.66	35,677.79
Cash in working fund	81,379.47	77,206.09
Total assets	612,346.82	472,235.59
Investments		
Book value of all investments	$483,572.94	$359,259.96
Market value, May 1	552,893.92	398,266.61

* Includes gift of $10,652 from the estate of the late W. S. Barstow.

PRESIDENT-ELECT HOUSLEY INTRODUCED

J. Elmer Housley (F '43) AIEE president-elect for the administrative year August 1, 1946, to July 31, 1947, was introduced by President Wickenden, who pinned upon Mr. Housley's lapel the official gold emblem of the Institute president, stating that "it symbolizes the fact that during the year to come the Institute will have sound, energetic, genial leadership, and that you will find yourself welcome from the farthermost reaches of northern Canada to the southernmost points of Mexico."

Mr. Housley's message as incoming president appears on page 394 of this issue.

The election of E. W. Davis, O. E. Buckley, T. G. LeClair, R. F. Danner, and C. F. Terrell as vice-presidents; J. F. Fairman, R. T. Henry, E. P. Yerkes as directors; W. I. Slichter as treasurer; has been reported in detail (*EE, July '46, p 330*).

AIEE PRIZES AWARDED

As Chairman Morris D. Hooven (F '44) of the AIEE committee on award of Institute prizes read the citations and called the winners forward, President Wickenden gave the award and a personal word of greeting to James DeKiep (M '43), L. R. Hill, and G. L. Moses (M '44), for having prepared and presented the best paper in the field of engineering practice; to G. D. McCann (M '44), C. E. Warren (A '41), and H. E. Criner, for having prepared and presented the best paper in the field of theory and research; to Aram Boyajian (F '26) for having prepared and presented the best paper in the field of public relations and education; and to G. W. Scott, Jr. (M '45) for the best initial paper.

A detailed report of the prize awards, including a listing of those who won honorable mention in the different categories, has been published (*EE, July ' 46, p 351*).

WESTINGHOUSE CENTENNIAL

In special recognition of the 100th anniversary of the birth in 1846 of George Westinghouse, whose name long has been prominent in the electrical industry, a special address entitled "George Westinghouse, Individualist" was presented by J. K. B. Hare, vice-president of the Westinghouse Electric Corporation. Mr. Hare's address is scheduled for publication in a subsequent issue of *Electrical Engineering*.

LAMME MEDAL TO PRINCE

With appropriate ceremony, President Wickenden presented the AIEE Lamme Medal to D. C. Prince (F '26) past president AIEE and vice-president of the General Electric Company, "for his distinguished work in the development of high voltage switching equipment and electronic converters," (*EE, Mar '46, p 130*). A brief outline of the history and significance of the Lamme Medal was given by C. M. Laffoon (F '45) of the Pittsburgh Section, acting for Doctor John C. Parker (F '12) of the New York Section, chairman of the AIEE Lamme Medal committee. A biographical sketch reflecting the personal and professional attainment of the medalist was presented by H. E. Strang (M '39) of the Schenectady Section. In his response, Medalist D. C. Prince gave an illustrated talk reflecting a few of the human interest aspects of some of his technical developments.

The complete story of the Lamme Medal presentation, including the several addresses, is scheduled for publication in a subsequent issue of *Electrical Engineering*.

ENTERTAINMENT FEATURES

A program of entertainment activities, carefully planned and well executed by the local committees, provided numerous inspection trips to points of technical interest, visits to points of artistic and historic interest, especially generous facilities for the annual golf tournaments, a twilight baseball game between the Detroit Tigers and the Boston Red Sox of the American League, a smoker for the men and a special dinner affair for the women, a wealth of separate affairs for the women including tea and a shopping tour across the border in Windsor, Ontario, topped off by the president's reception and a general dinner dance.

GOLF TOURNAMENTS

The Mershon trophy was won by Tomlinson Fort (M '35) of the Pittsburgh Section, one up over G. A. Kositzky (F '29) of the Cleveland Section; Fort and Kositzky having defeated K. M. Smith (M '33) and H. E. Wulfing (F '44) of the Chicago Section in the semifinals. The Mershon trophy was presented to the AIEE by Past President R. D. Mershon (F '12) and is available for competition by Institute members on the basis of match play and handicap. The trophy remains in the permanent possession of the Institute, on display in the member's reception room at AIEE headquarters in New York. Each winner is entitled to have his name engraved upon the trophy, and receives also a suitable memento of the occasion. The present trophy is the third such trophy donated by Doctor Mershon, the first two having been susceptible of being won permanently. The names appearing on the Mershon trophy now will be as follows:

1946	Tomlinson Fort (Pittsburgh Section)
1942	H. G. Schultz (Chicago Section)
1941	D. S. MacCorkle (New York Section)
1940	H. A. McCrea (Boston Section)
1939	F. R. George (San Francisco Section)
1938	T. O. Rudd (New York Section)
1937	C. H. Teskey (Cleveland Section)
1936	Carl E. Johnson (Los Angeles Section)

The Lee trophy was won by K. M. Smith of the Chicago Section, with H. E. Wulfing of the Chicago Section as runner-up. The Lee trophy was presented to the Institute in 1932 by the late Past President W. S. Lee, for competition among Institute members on the basis of lowest net score for 36 holes. The Lee trophy must be won twice by the same player for permanent possession. In the meantime, the trophy is on display at AIEE headquarters in New York, and the list of names of winners engraved upon it now will read:

1946	K. M. Smith (Chicago Section)
1941	T. H. Hogg (Toronto Section)
1940	H. E. Wulfing (Chicago Section)
1939	W. G. B. Euler (San Francisco Section)
1938	T. A. O'Halloran (Washington Section)
1937	G. A. Kositzky (Cleveland Section)
1936	H. S. Warren (Los Angeles Section)
1935	A. H. Sweetnam (Boston Section)
1934	F. M. Craft (Georgia Section)
1933	G. R. Canning (Cleveland Section)
1932	C. H. Teskey (Cleveland Section)

The exceedingly small number of registrants for the golf tournaments precluded the usual District team competitions, and otherwise generally disappointed the local committee which had made extensive and generous arrangements in anticipation of a lengthy registration of golfing enthusiasts. The tournaments were played at the Glen Oaks Golf and Country Club.

Electrical Contracting photo

W. E. Wickenden (F '39) outgoing president of AIEE (left) greets President-Elect J. E. Housley (F '43) at the summer convention

COMMITTEES

Essential to any successful convention is the hard work done over a long advance period by the volunteer group comprising the various local convention committees. The pronounced success of the summer convention in Detroit is creditable to the following committees:

General Committee

S. M. Dean, *chairman;* T. G. Glenn, *vice-chairman;* W. F. Wetmore, *secretary–treasurer;* A. H. Lovell, *District representative;* L. W. Clark, *Michigan Section chairman;* G. M. Chute, Jr., *Michigan Section secretary–treasurer.*

Hospitality Committee

M. A. Bergdahl, *chairman;* E. R. Moore, *vice-chairman;* E. B. Anderson; F. Bauer; A. B. Buchanan; G. M. Chute, Jr.; L. W. Clark; M. R. Horne.

Meetings and Papers Committee

A. E. Kriegsmann, *chairman;* A. W. Rauth, *vice-chairman;* J. S. Ambrose; J. S. Francis; C. H. Heiney; J. G. Hemstreet; H. L. Lindstrom; D. B. Masters; A. R. Satullo; W. C. Smith; J. W. Tracht; C. E. Waits.

Sports Committee

D. D. Chase, *chairman;* W. E. Losie, *vice-chairman;* A. S. Albright; L. E. Donelson.

Hotels Committee

H. W. Collins, *chairman;* H. J. Morton, *vice-chairman;* O. J. Marshick; R. Pogorzelski; L. B. Potter; V. E. Schafer; P. A. Tracht.

Publicity Committee

A. J. Koetsier, *chairman;* A. P. Fugill, *vice-chairman;* E. L. Hubbard; R. E. Kratzer; R. H. Mertz; H. Paransky.

Inspection Trips Committee

R. C. Spaulding, *chairman;* J. G. Spaulding, Jr., *vice-chairman;* E. L. Bailey; W. J. Campbell; E. L. Hubbard; K. W. John; H. F. Wall.

Information and Transportation Committee

W. J. Piper, *chairman;* A. R. Hellwarth, *vice-chairman;* A. E. Bush; C. E. Fishback; E. D. Kane; R. L. Rayner; E. Sakolov; D. E. Trefry; L. R. Wagner; H. F. Wall.

Finance Committee

V. J. Snyder, *chairman;* G. A. Strohmer, *vice-chairman;* G. M. Chute, Jr.; D. D. Douglass; R. Foulkrod; J. G. Hemstreet; H. M. Hess; W. F. Wetmore; W. R. Williams.

Registration Committee

F. R. Temple, *chairman;* W. G. Knickerbocker, *vice-chairman;* E. L. Bailey; D. H. Baker; G. M. Bunting; H. M. Craig; J. H. Schumann; H. P. Seelye; H. W. Sherwin; M. R. Steffins.

Ladies' Hospitality Committee

Mrs. M. A. Bergdahl, *chairman;* Mrs. S. M. Dean, *vice-chairman.*

Hospitality Subcommittee

Mrs. M. M. Cory, *chairman;* Mrs. H. Cole; Mrs. H. W. Collins; Mrs. S. M. Dean; Mrs. R. E. Greene; Mrs. V. J. Snyder; Mrs. H. F. Wall.

Yacht Club Luncheon Subcommittee

Mrs. F. R. Temple, *chairman;* Mrs. E. C. Balch; Mrs. G. M. Chute, Jr.; Mrs. J. H. Hunt; Mrs. T. N. Lacy; Mrs. W. J. Pefferly.

Dinner and Bingo Party Subcommittee

Mrs. D. D. Chase, *chairman;* Mrs. C. C. Adams; Mrs. T. R. Halman; Mrs. E. R. Moore; Mrs. W. F. Wetmore.

Greenfield Village Subcommittee

Mrs. L. W. Clark, *chairman;* Mrs. D. D. Douglass; Mrs. C. E. Fishbeck; Mrs. M. R. Horne; Mrs. L. B. Potter; Mrs. R. C. Spaulding.

Trip to Canada Subcommittee

Mrs. L. I. Komives, *chairman;* Mrs. A. S. Albright; Mrs. A. P. Fugill; Mrs. F. M. Hull.

Analysis of Registration at 1946 Summer Convention, Detroit, Mich.

Classification	Districts											
	1	2	3	4	5*	6	7	8	9	10	Elsewhere	Total
Members	131	232	60	40	360	11	25	14	10	37		920
Men guests	24	54	8	1	146	2	6	2		9	1	252
Women guests	22	30	9	11	74	5	11	5	2	1		170
Students	1				7					1		9
Totals	178	316	77	52	587	18	42	21	12	48	1	1,351

* District in which Detroit is situated.

Institute Activities Reviewed at Officers and Delegates Conference

Based upon the success and popularity of previous experiment, the Sections committee this year arranged a total of six separate conferences:

1. Main conference of officers, delegates, and members.
2. Conference on Section operation and management for the 19 larger Sections.
3. Conference on Section operation and management for the 29 Sections of intermediate size.
4. Conference on Section operation and management for the 28 smaller Sections.
5. Conference on Section activities in connection with local councils of engineering and technical societies.
6. Conference on Section–Branch co-operation.

Attendance at all sessions was very good, and included many officers and members other than the responsible delegates. Official delegates were present from all of the 10 Districts, and from 72 of the 75 Sections. The Sections not officially represented were Beaumont, Columbus, Fort Wayne, and Mansfield.

The following report is devoted to the general conference of officers, delegates, and members held Tuesday afternoon, June 25, 1946; the other conferences are reported separately, elsewhere in this or in a subsequent issue.

With Vice-Chairman R. M. Pfalzgraff (M '41) of the Philadelphia Section presiding, and A. C. Muir (M '39) of the Philadelphia Section acting as secretary, the conference program was arranged as follows:

1. Opening remarks by chairman.
2. Observations on Institute activities by Doctor W. E. Wickenden (F '39) AIEE president, of the Cleveland Section.
3. Opportunities for Section activities in the industrial field by President-Elect J. Elmer Housley (F '43) of the East Tennessee Section.
4. District and Section activities by Secretary H. H. Henline.
5. Sections committee report and forecast by G. W. Bower (M '40) of the Philadelphia Section, chairman of the Sections committee.
6. Progress report of committee on planning and co-ordination, pertaining to its study of Institute activities, by J. F. Fairman (F '35) of the New York Section, AIEE vice-president and chairman, committee on planning and co-ordination.
   (*a*). Technical activities subcommittee, by M. D. Hooven (F '44) of the New York Section, chairman of the subcommittee.
   (*b*). Professional activities subcommittee by T. G. LeClair (F '40) of the Chicago Section, chairman of the subcommittee.
7. Section membership activities and its relation to the progress of the Institute, by L. F. Howard (M '25) of the New York Section, chairman AIEE membership committee.
8. Institute finance and its relation to the Section, by W. R. Smith (F '30) of the New York Section, chairman AIEE finance committee.
9. Reports of the first year of operation of the two newest Institute Sections
   (*a*). Beaumont Section.
   (*b*). Illinois Valley Section.
10. Educational courses conducted by the Sections by H. W. Bibber (M '30) of the Schenectady Section, chairman AIEE committee on education.
11. AIEE publication services, by G. Ross Henninger (F '43) AIEE editor.
12. Section history by M. S. Coover (F '42) of the Iowa Section, AIEE vice-president.
13. General discussion.

PRESIDENT COMMENTS ON SECTION VISITS

President Wickenden reported that he had come back from his extended tours of visitations to AIEE Sections with "an indelible impression of the activity and the vitality of the Institute as expressed through its whole activity. . . . The Institute, through its local units, is setting the pace of professional activity over the country, setting it through widely diversified programs with an over-all scope for groups having specialized interests and aims and an attractive fare of general discussions and activities, and a social life that must gladden the hearts of the founders, who put equal weight upon the fraternal relations and the technical activities of the Institute, as these founders look over the rim of the other world and keep track of us.

"I was impressed, too," said Doctor Wickenden, "with the zeal with which the subsection activities over the country are pushing out our organized front. One cannot fail to be impressed by the great position of leadership which the Institute is exercising in the development of co-operative activities. . . . One finds in meeting representatives of the Institute of Radio Engineers that we are of one mind in regretting that there ever was a situation that tended to encourage a separation of interests between these two great bodies, and one finds an equal desire, apparently on both sides, that the evolution may be so guided that in the course of time . . . there may be a progressive coalescence of interests which might stimulate and result in the ultimate unity in the great field of electrical science and industry.

"Also, one is impressed by the unique value of the Institute in its solid trinational organization. In fact we are unique in being firmly established alike in Canada, in the United States, and in Mexico. It is of potentially great worth to us and to the nation that this bond of sympathy and understanding and collaboration . . . is being built up. . . . One is very happy to find that Canadian and Mexican members take great pride and satisfaction in their association with the Institute, and aspire to carry their full weight in its growth in numbers and in activity.

"I could not help being impressed by the significance of the great movement toward industrialization which is getting under way in Mexico City, and the unique opportunity which we of the Institute have not only to strengthen, but also to broaden, activities there, looking forward to the day when Mexico may stand with our Canadian neighbor on the north, as a fully developed geographical Section of the Institute with a vice-president representing it."

In paying tribute to the AIEE Sections committee for its indefatigable leadership and dynamic program, Doctor Wickenden reported to the conference that he came back from his field trips "with the impression that the energizing source for much of this vigor which the Institute shows is the Sections committee. I simply could not let this opportunity go by without expressing the admiration that your national officers have for the work which has been carried forward through that committee under the leadership of its chairman Mr. Bower. I do not believe that a finer job of organization has been done by any committee in any national engineering organization. These things are reflected in the membership gains of the Institute; they are reflected in the particularly strong financial position of the Institute; they are a challenge, I believe, to our national body to become as inclusive and as adaptive to new conditions, as enterprising in meeting and taking advantage of new situations, and as co-operative on the plan of our broader interests, as the local units of our organization have proved themselves so worthily to be."

PRESIDENT-ELECT EMPHASIZES IMPORTANCE OF INDUSTRIAL ELECTRICAL ENGINEER

President-Elect Housley laid especial stress on the need for expanding AIEE activities to serve more adequately the very large block of electrical engineers engaged in one or more of the many phases of industrial applications and industrial operations. He said: "I have been anxious to bring to your attention the problem of the industrial electrical engineer with which I have been struggling for some 30-odd years. The Institute has done a great deal for the industrial electrical engineer, but . . . we have a greatly expanded field of industrial activity, and we need to cover that field more adequately.

Mr. Housley called attention specifically to the importance of full AIEE participation in the work of Engineers Council for Professional Development. He spoke also of more active co-operation between the Sections and the AIEE committee on safety, with reference to the electroindustrial field. He challenged the membership committee with the statement that "The industrial field is wide open, and the surface has been scratched so far as membership possibilities are concerned . . . continued industrial expansion gives us an opportunity to share AIEE benefits with the engineers of industrial plants."

The essential substance of Mr. Housley's further comments are embraced in his "Message From the President" on page 394 of this issue.

SECRETARY HENLINE DESCRIBES SECTION AND DISTRICT DEVELOPMENT

Emphasizing that one of the most important benefits accruing from the steadily broadening fields of activity of the Institute's Sections and Districts is the increased opportunity for active participation in Institute affairs by individual members, Secretary Henline stated that "Much of the progress of the Institute during the past 25 years has been the direct outgrowth of the soundness of the District and Section plans of organization, and the effectiveness of the activities carried on through the contribution of a very large number of individual members. This plan for organization of Districts came into being in 1920, after comprehensive studies by the AIEE committee on development, and was intended primarily to give members a closer contact with Institute officers, to develop interests among the younger members in particular, and to stimulate Section activities. I think that today, 25 years later, we can agree that the plan accomplished these objectives. . . .

"District activities, as carried on today, have evolved through numerous steps starting with the formation of the District executive committees as established in the by-laws, the subsequent provision for traveling expenses to a yearly meeting in each District, establishment of District prizes for technical papers, the appointment of District Student Branch counselors, the authorization of allowances for traveling expenses for District conferences on student activities, and other developments including the recent authorization for Sections to send three representatives instead of two to the District meetings. . . . Since the first District meeting was held in 1924, 50 such meetings have been held. They are intended to serve somewhat the same purpose as Section meetings, but on the larger physical scale of the geographical District, so that subjects of primary interest in the several Districts may be given appropriately specialized attention for the benefit of the members in those Districts.

"One of the most striking developments in Institute affairs has come within the past few years, in the remarkable expansion of Section activities. Some of the Institute's Sections have been in operation since 1902. Members in New York City held monthly meetings beginning in 1886; in Chicago beginning in 1894. The development of AIEE local Sections as an important part of the AIEE national program began in 1902 under the driving stimulus of the late Doctor Charles F. Scott who was president at that time.

"Reflecting on the growth of the Institute, we find the membership on May 1, 1902, to have been 1,549; on June 1, 1946, it was 25,218. We find in 1920, an Institute membership of 11,345 with 36 Sections holding 262 meetings that year; whereas during the fiscal year just closed, 75 Sections, 26 Subsections, and 82 technical groups held 1,187 meetings. The average number of Sections meetings for the fiscal year which ended April 30, 1920, was 7.3 meetings per Section; for the 1941–42 fiscal year 9 meetings per Section; for the 1945–46 fiscal year just closed April 30, 15.8 meetings per Section. A few years ago we thought a Section was carrying a normal load of activity if it held something like 8 or 9 meetings per year; now the average is nearly 16 meetings per year, in addition to educational courses and active participation in local joint engineering councils. At present Institute Sections participate in at least 45 local engineering councils; so far as is known, there is no local council located in an area covered by an Institute Section in which the Section is not active.

"The 125 Student Branches have had some difficulties in recent years, and nearly one third of them were inactive at some time during the war, but most of them already have resumed normal activities or expect to do so this coming fall.

"An index of the importance of student activities is given in the fact that during the past 15 years some 10,000 Associates have come into AIEE membership from the status of Student membership—some 40 per cent of all Associates elected during that period.

One of the most important functions of the Institute is to participate in the development of the individual—to help individuals in their own advancement—and this is being accomplished through the Branches at the start, later through the Sections activities, through the broadened District activities, and finally through participation in AIEE national affairs. All Institute activities are on a purely voluntary basis. No one is compelled to do anything. Therefore, results are attained by the adoption of activities that will stimulate and maintain maximum interest among a large number of qualified members.

"Special efforts are being made to provide greater flexibility in AIEE organizational structure, and greater diversity of opportunity for individual participation in a broadened program of AIEE activities, so that members almost anywhere may have the privilege of coming together and discussing problems of common and current interest. Recent developments in AIEE Sections activity have expanded such opportunities to an extent which now constitutes a challenge to the other division of AIEE activities, to attain equivalent effectiveness."

SECTION RECORDS REPORTED; NEW RECORDS FORECAST BY BOWER

The administrative year just closing has been a record year for AIEE Section activities, according to reports presented by G. W. Bower, chairman of AIEE Sections committee. He reported that "For several years prior to 1943, the number of Section and Branch meetings, together with totaled attendance at those meetings, had been decreasing progressively each year . . . reaching a low of 598 meetings with slightly over 66,000 total attendance in 1943." Progressive increases since that time led to the all-time record activity established for the fiscal year ended April 30, 1946, which showed a total of 1,187 meetings with an attendance total of something more than 116,000. These increases are of especial significance and importance, inasmuch as they occurred during the period of the war emergency.

"The organization and operation of technical groups and Subsections and the increase in other Section activities have been largely responsible for these results," stated Mr. Bower. "I look for a substantial increase in these figures during the forthcoming year . . . it should be the goal of every Section chairman to see to it that his Section contributes to this effort." Calling attention to the detailed report of the Sections committee included in the "Report of the Board of Directors" (*EE, July '46, pp 331–50*) Chairman Bower recounted some of the chief events of the year. A plan of increased national appropriation for additional Section activities; the formation of two new Sections—Beaumont (Texas) and Illinois Valley—during the year; transfer of the Mexico Section from the jurisdiction of the New York District (3) to the South West District (7); the transfer of the territory of Hawaii from New York District to the territory of the San Francisco Section in the Pacific District (8). "The pioneering spirit of the San Francisco Section was demonstrated by the efforts of its members to form a Subsection in the Hawaiian Islands," stated Mr. Bower, who reported further that:

"The development of technical groups is a very important part of the plan to retain the diversified interests of the older members, as well as to attract new members . . . the chairman of each Institute technical committee was contacted at the beginning of the year in an effort to enlist the co-operation of the individual members of these committees to encourage the development of new technical groups in their local Sections, as well as assist in the operation of such groups. The value of such groups operated within a Section is becoming recognized more generally throughout the country. The number in operation increased from 51 to 82 during the year; many others are in process of formation.

"Subsection operation is a valuable means of accomplishing the important objectives of the Institute, by providing additional meeting places at which papers on electrical engineering subjects may be presented and discussed. Many opportunities exist for members to participate in Section activities through the development of Subsections. . . . Subsection operation is becoming more popular each year as its advantages are recognized more widely." Eleven Subsections started during the past year have brought the total to 26; a total of 35 or more is expected to be in operation by the spring of 1947.

"Co-operation with other societies at the local level is being covered very satisfactorily by local councils of engineering and technical societies . . . in 45 metropolitan areas . . . which includes practically all the larger centers of population. This local council movement is spreading very fast, and I am sure that it soon will include all remaining metropolitan areas. The AIEE local Sections have been very active in many areas in the organization and operation of these local councils, and the Sections committee has encouraged this activity.

Mr. Bower reported that the Sections committee had worked very closely with the vice-presidents, keeping them completely informed on Section committee plans. Specifically: "The vice-presidents held individual meetings on Section operation and management problems in connection with their District meetings in the fall of 1945. . . . These meetings were very successful. . . . This co-operation with the vice-presidents has been very profitable to the Institute and . . . should be encouraged and extended further." Mr. Bower reported further that the Sections committee had prepared and distributed a plan of Section–Branch co-operation, as a joint project with the committee on Student Branches; prepared and distributed a plan of suggested educational courses, as a joint project with the committee on education; is planning to encourage safety activity in the Sections as a joint project with the committee on safety. "Co-operation between Institute committees is very profitable for the Institute," said Mr. Bower, "it should be encouraged and extended throughout the Institute. More emphasis should be placed on this internal co-operation.

"Developments in the field of electrical engineering have expanded greatly during the period of the war emergency. Activities of the Institute also have expanded during this period, but the Institute must keep abreast in the diversification and expansion in the electrical engineering field in order to retain its leadership in this field as a Founder Society," urged Mr. Bower, "the Institute covers the entire broad field of electrical engineering, and it would lose much of its effectiveness if it were to surrender any of this broad field. Competition by specialized technical societies may become greater in the future, but if the Institute is fully alert to its responsibilities in the broad field of electrical engineering, this competition should be both stimulating and helpful."

PROGRESS REPORTED ON PLANNING AND CO-ORDINATION PROJECT

Studies currently being made by the AIEE committee on planning and co-ordination toward the objective of extending and improving the effectiveness of AIEE activities were outlined briefly by AIEE Vice-President J. F. Fairman, chairman of that committee. The phase of this study concerned with technical activities was enlarged upon briefly by M. D. Hooven, chairman of the subcommittee on technical activities and chairman of the AIEE technical program committee. The phase concerned with the so-called "professional" aspects was enlarged upon in some detail by Chairman T. G. LeClair of the subcommittee on professional activities. The subject matter embraced in these discussions has been included in reports variously published in *Electrical Engineering* during recent months, and given in some detail in the April issue (*pp 169–73*).

SECTION MEMBERSHIP ACTIVITY IN RELATION TO INSTITUTE PROGRESS

The importance of aggressive and constructive membership activity on the part of each Section, and the importance of selecting the right Section personnel for membership activity, were stressed by Chairman L. F. Howard of the AIEE membership committee. Statistics reported by Mr. Howard included the following: The Institute membership growth of 17.8 per cent, from 21,407, on April 30, 1944, to 25,218 as of June 1946, a two-year period; 500 applications currently pending; student membership at 5,087, as compared with a prewar high of 5,926 and a wartime low of 4,613; peak of 2,500 (in 1945) given "inactive status" because of military service, the total having dropped to less than 1,700 in June and steadily dropping as unsolicited requests for reinstatement are received daily; re-election or reinstatement of former members amounting to 401 for 1945–46, 366 for 1944–45, 301 for 1943–44; transfers from Associates and Member grades to higher grades of membership, 559 for 1945–46, 464 for 1944–45, and 420 for 1943–44; total losses in membership from all causes for 1945–46, 600, as compared with 702 for 1944–45.

"Such a growth is fascinating and stimulating," reported Mr. Howard, "can it be that this growth just happened? It would seem clear that world conditions generally and the industrial development outlook, as so clearly outlined by Mr. Housley, emphasize a need for persons to be alert to developments pertaining to all branches of electrical engineering. Granting that the AIEE naturally should be the organization favored to carry on effectively and to meet the challenge of the times, because of the unique position it has held in the field of electrical engineering development since 1884.

"There are other influences which have aided in membership work, particularly in the past few years. Much effort has been directed toward developing methods in membership work which would be suitable to the times and the conditions existing in the various Sections. . . . The 'Membership Committee Guide' has been made available to Section membership committees, and is available to all others interested . . . the recently issued booklet 'Membership Information' likewise should be helpful . . . the keeping of careful records by the Section secretaries and by the Section membership chairmen is important, and the passing of this information to successors has proved to be extremely helpful in maintaining continuity of effort.

The Sections committee during the same period has been more than usually active. . . . This in turn has aroused, broadened, and quickened the interest of the individual members, and additional qualified persons have become interested.... The membership committee can be instrumental in obtaining new members, but the membership committee cannot keep those members interested if other activities of the Institute do not give the members attractive programs and provide opportunities to keep the interest alive.

"It is the job of the membership committee, and it falls heavily on the Section membership personnel, to be ready at all times to assist in acquainting qualified persons with the advantages of becoming AIEE members. . . . Membership work is an important although not spectacular part of Institute activities. Membership work should . . . be a service from which real pleasure should result. Men who truly like people, and can approach them comfortably and sincerely, be responsive, and listen well, should welcome a call to serve on membership committees. Part of the membership gain which has been experienced in recent years must be credited to these factors. Personnel of the membership committee throughout the AIEE, with especial emphasis on Section membership personnel, has been particularly responsive.

It is through the Sections that new membership material is to be obtained, and present membership retained. We have the ability, the energy, the enthusiasm, and the courage to see that all the activities of the Sections are so correlated that we will be alive constantly to the technical, economic, and industrial developments, and thus assure that the influence and prestige of the AIEE will be even greater in the years to come than it has been in the past.

INSTITUTE FINANCE AND ITS RELATION TO SECTIONS

Increases in appropriations for Section activity expenses, and the correlative responsibility of Sections to make wise and productive expenditures of such appropriations, were outlined by Chairman W. R. Smith of the AIEE finance committee. He emphasized that the consistently sound financial condition of the Institute is the direct and accumulative result of the judgment, conservatism, and consistent efforts of finance committee personnel throughout the years. He emphasized also that essentially the only source of Institute income is membership dues, and that the constant problem of the finance committee is to weigh and evaluate suggested expenditures to assure continuing solvency on the one hand and achievement of the greatest over-all good for the Institute on the other hand.

Mr. Smith outlined current Section allotments, reporting the recently revised schedule of Section appropriations as follows:

1. Basic allowance per Section $200.
2. Additional allowance $1.20 per member.
3. Additional allotment: for 12 to 17 meetings, $50; for 18 to 23 meeting, $100; for 24 to 29 meetings, $150; and for 30 or more meetings, $200.
4. Additional allotment for each Subsection active $100.

Mr. Smith urged each Section to establish a budget and finance committee, to provide for specialized attention to this important phase of activity and to assure the most effective co-ordinated use of available funds, as well as to avoid overcommitment and overexpenditures.

NEW SECTIONS REPORT

In June 1945, two new AIEE Sections were organized formally, the Beaumont Section in Texas, and the Illinois Valley Section in the vicinity of Peoria.

Responding to a request for comments reflecting experiences of the initial year of operation, Chairman F. E. Dace of the Illinois Valley Section reported a 62 per cent growth in membership, from 47 at the beginning of the year to 76 as of May 10, 1946. He reported further that during two years functioning of the group, including the year preceding their formal organization as a Section, 12 formally scheduled Section meetings and seven technical group meetings had been held in addition to two inspection trips, with a total attendance of 1,580 persons. The Section also is an active participant in the local engineering council, and is a member of the Illinois Engineering Council in recognition of the need for keeping in touch with affairs of an engineering nature throughout the state. The Beaumont Section was not represented at the conference.

SECTION EDUCATIONAL COURSES

A responsibility of the engineering school, in addition to giving its students a formal education in accordance with its curricula, is to impress upon those students that education is a continuing lifelong process, if they would keep up with the requirements of their profession; a combined responsibility and opportunity of the AIEE through its local Section is to assist the engineering graduate in his continuing education and professional experience, according to Professor H. W. Bibber, chairman AIEE committee on education. Professor Bibber pointed out that Sections currently have before them "two very specific opportunities; (1) of enabling the returning veterans who already have graduated from school to readjust themselves again to the technical side of engineering work; (2) to reconvert certain people who during the war were engaged in activities other than those in which opportunity now exists. In general we feel that the function of the Sections educational committee is to stimulate educational activity in the Section territory by whatever means may be most appropriate locally," he continued.

With respect to the establishment of educational courses by Section educational committees, Professor Bibber urged that full advantage be taken of facilities that might be arranged through established educational institutions within the Section territory, or of extension facilities of state universities or even other educational institutions more distantly located. He invited Sections to seek the advice of the AIEE committee on education concerning any problems within its province with which they might be confronted.

AIEE PUBLICATION SERVICES

A brief survey of current AIEE publication services was given by G. Ross Henninger, AIEE editor, based upon the following outline:

1. Advance pamphlet preprints of technical program papers.
2. *Electrical Engineering.*
   (*a*). General articles and news.
   (*b*). Transactions section.
3. "Transactions Supplement to Electrical Engineering."
   (*a*). June issue.
   (*b*). December issue.
4. AIEE annual *Transactions.*
5. Miscellaneous publications.

In comparison with this publication program which has been followed since 1938, Mr. Henninger briefly reviewed the history and evolution of AIEE publications from the original *Proceedings* as a meetings report, and *Transactions* as an annual repository of formally approved material. He also gave a brief preview of plans now being developed with the publication committee further to expand the scope of published material and to improve its distribution. Details of these plans will be enlarged upon in a later issue of *Electrical Engineering.*

SECTION HISTORY

The importance of maintaining a contemporary Section history was emphasized by Vice-President M. S. Coover, who urged that each AIEE Section establish and maintain a history committee. Mr. Coover suggested that the function of such a committee would be to build a history of local Section activity and of significant electrical developments in the territory of each Section. He urged immediate action of this project, in order that historical committees might have access to first hand information from many of the "old timers" who have grown up with the industry and are still available.

Four Papers Presented at Quality Control Conference

A conference on management and quality control was held June 28 during the summer convention in Detroit with W. P. Dobson (F '43) presiding. The following account of the conference was prepared by P. L. Alger (F '30) vice-president in charge of design engineering of the General Electric Company. In opening the meeting, the chairman reviewed the program of the Standards subcommittee on applications of statistical methods over the past year in organizing conferences and publishing a series of educational articles in *Electrical Engineering.*

W. S. Oliver, president of the Michigan Society for Quality Control, speaking on the topic, "Introducing Quality Control to Management," remarked that the newly formed national Society for Quality Control has over 2,000 members and some 21 regional organizations. Experience in war production has given a great impetus to the use of modern quality control methods throughout industry, but attention now is concentrated as much, or more, on human problems as on technical matters, according to Mr. Oliver. To introduce quality control into a plant, he recommended first the selection of some troublesome problem, such as a persistent defect, or absenteeism, or an unsatisfactory material, and then to devote a considerable period to collecting data on this one problem. After study involving preparation of charts showing daily variations, as related to different conditions, a report may be developed, showing the dollars saving that would result if the variations could be eliminated. By presenting this to management, support can be gained for a control program. Then, by careful selection of additional problems, maintenance of control charts on their variations, and preparation of a factual report on possible savings, the confidence of management can be gained. Ample time, probably six months, should be allowed for this building up of facts and confidence, before personnel is assigned to put quality control into effect throughout a plant.

The next speaker, James Rayer, superintendent of inspection, Timken Detroit Axle Company, stated that, when he first took a course in statistical quality control, he believed the methods were applicable only to large-scale production—an impression that has been generally shared by management. As presented, the course seemed academic—as though developed by men who knew nothing whatever of manufacturing. However, the evident ability of the instructors, and their conviction of the value of statistical methods, led him to continue to read and to think about them, with the end result that quality control now has been given the enthusiastic support of management in his company.

Mr. Rayer illustrated his remarks with a number of applications in the manufacture of axles, such as the study of variations in Brinell hardness and in the tightness and fits of wheel bearing adjusting nuts. Distribution charts of shaft hardness in one case showed a variation much wider than justified. Samples taken at various stages of the processing revealed the fact that some of the shafts were decarburized by overheating. Correcting the process at this point resulted in far more uniform production and important dollar savings. The same procedure of making distribution curves on samples of critical parts drawn from production, finding the spread to be wider than reasonable, tracing down and correcting the causes, and finally instituting control charts to maintain quality, is yielding very satisfactory gains in both quality and cost.

D. E. Durst, product control manager, United States Rubber Company, introduced his talk, "Plant Organization for Quality Control," by saying that times have changed since the days when "Bar X" meant a ranch in Wyoming—now manufacturing men recognize it as a symbol of "chart control"—the term that has been coined to describe the use of statistical methods for the control of quality. Mr. Durst said further that, in his opinion, quality control should be called "quality through people," since its success depends on inspiring operators as well as foremen to a creative interest in the quality of their work.

How to deal with people is an essential in training quality control engineers, Mr. Rayer declared. Twice as much time is spent on the human side as on the technical side of quality control in the course under his supervision. By making a control chart on each machine, and giving the operator the means for determining just how good his work is, a new interest is aroused, and a competitive or team spirit is developed, which produces benefits far outweighing the initial objectives.

In the absence of the author, G. S. Berge presented the paper, "Organization of Quality Control as a Management Tool," by T. D. Foy, supervisor of cost reduction, General Electric Company, Schenectady, N. Y. In Mr. Foy's opinion industry is more "tolerance conscious" than ever before; dimensions now often are required to be accurate to small fractions of a mil to meet customers' demands for higher quality products and interchangeable parts. In a large plant, where the operations of engineering, material ordering, planning and methods, manufacturing, and inspection and test all are organized separately, the problem of team work becomes all important. Quality control cannot be assigned to any one of these groups, but must be shared by all of them. Under this broader concept, quality control may be defined as "any organized management effort, statistical or otherwise, to establish and maintain required quality levels by suitable corrective and preventive action."

After consideration and trial of many different organization methods, Mr. Foy's experience indicated that the best plan in a large company is to make the quality control program the direct responsibility of management. In a typical division of his company, management is represented by an engineer responsible for the design and development of the product and a superintendent responsible for its production. The quality control program, therefore, is directed by a quality control co-ordinator reporting directly to the superintendent, and a quality control engineer reporting to the engineer in charge, these two men working in close co-operation. In this way all of the activities of developing, material ordering, planning, manufacturing, and inspecting can be organized to produce the most effective results. This program in no way relieves the foreman or the engineer from their immediate responsibilities for quality. Instead it provides them with facilities for applying distribution curves, control charts, and sampling tables to their problems.

Operation and Management Are Topics at Section Conferences

To afford time and opportunity for more thorough discussion of problems of common interest, and for the exchange of experiences among Sections of approximately similar size, the AIEE Sections committee arranged three separate and parallel conferences at the summer convention in Detroit, one for the larger Sections, one for the intermediate Sections, and one for the smaller Sections. These conferences were well attended, not only by the delegates of the Sections in the three groupings, but also by many Institute officers and other members.

COMMON PROGRAM

The conferences were conducted in an entirely informal manner, each session developing by discussions and questions from the floor. As a general theme for the guidance of major discussion, and to assure that certain important points were brought into the discussion, as well as to provide a pattern for future reference and use, the Sections committee arranged the following common program for the three conferences:

1. Operating committees.
2. Technical groups.
3. Fellowships.
4. Section prize paper competition.
5. Liability of Sections for injuries at meetings.
6. Subsections.
7. Other activities.

These sessions were held Monday afternoon, June 24, 1946, in conference rooms at the Detroit-Leland Hotel, a short distance from convention headquarters.

LARGER SECTIONS

With A. C. Muir (M '39) and H. H. Sheppard (A '34), both of the Philadelphia Section, presiding respectively as chairman and secretary, the conference of larger Sections included delegates from the following Sections:

Boston
Chicago
Cleveland
Connecticut
East Tennessee
Los Angeles
Lynn
Maryland
Michigan
Milwaukee
New York
Philadelphia
Pittsburgh
St. Louis
San Francisco
Schenectady
Seattle
Toronto
Washington

High lights of this conference, as furnished by Secretary Sheppard, are reflected in the following. Experiences reported by the larger Sections indicate that an increase in the number of active operating committees is of value in furthering the administrative work and general activities of the Section comparable with the value of additional technical committees and groups in the furtherance of Section technical activities. One of the most active of such committees reported upon was a veterans committee to advise returning servicemen concerning their educational and employment problems through the medium of informal meetings which provide the benefit of direct council and conference with selected engineers representing the different branches of the profession. The 31 new technical groups activated during the year have brought the total to 82, with many more currently in process of formation and scheduled for activation with the opening of the fall season.

Typical of the experience of the larger Sections in the matter of Subsections, is that of the San Francisco Section with reference to Subsections, one at Sacramento about 90 miles away, and one at Fresno about 180 miles away. These two thriving and semiautonomous groups have been developed in areas in each of which it was reported that there were only two active AIEE members prior to the initiation of Subsection activity.

The following two resolutions were adopted unanimously:

1. Resolved that AIEE headquarters furnish to the secretary of each Section the names of references of newly elected members.
2. Resolved that the booklet on national and District prizes, now being revised, include a chapter giving recognition to Section prize paper competition, and making available financial assistance to those Sections having prize paper competitions.

The argument in favor of resolution number one, is that it would enable the Sections to encourage the attendance of newly elected members through contact with the supporting references. The argument in favor of resolution number two represented the strong feelings, long held by the more active Sections, that paper prize competition at the Section level is at least as important, if not more important, than such competition at the District and national level.

The delegates and members present at the conference were enthusiastic about the success of the meeting and recommended continuance of the idea at subsequent summer conventions.

INTERMEDIATE SECTIONS

With R. M. Pfalzgraff (M '41) and W. F. Henn (A '41), both of the Philadelphia Section, presiding respectively as chairman and secretary, the conference of intermediate Sections included delegates from the following Sections:

Akron
Central Indiana
Cincinnati
Dayton
Denver
Florida
Fort Wayne
Georgia
Houston
Kansas City
Lehigh Valley
Mexico
Minnesota
Montreal
New Orleans
Niagara Frontier
North Carolina
North Texas
Oklahoma City
Pittsfield
Portland
Providence
Rochester
San Diego
Sharon
Spokane
Springfield
Vancouver
Virginia

The delegates from the intermediate Sections also adopted the resolution calling for some provision for Section prize paper competitions in the rules of the committee on award of Institute prizes. Chairman Pfalzgraff further urged that each Section form a prize paper committee. This activity was discussed by C. W. Lytle (M '42) of the Kansas City Section, A. D. Forbes (M '42) of the Sharon Section, and D. D. MacCarthy (A '28) of the Pittsfield Section.

A promise of increasing numbers of technical groups and Subsections in the coming year could be gathered from the attitudes of those taking part in the discussion. Experiences with technical groups were related by C. W. Lytle, W. M. Allen (M '44) of the Portland Section, J. D. Hershey (A '40) of the Niagara Frontier Section, and A. J. Hendry (A '39) of the Minnesota

Future AIEE Meetings

Great Lakes District Meeting
Indianapolis, Ind., October 9–11, 1946

Winter Meeting
New York, N. Y., January 27–31, 1947

North Eastern District Meeting
Worcester, Mass., April 23–25, 1947

Section. Subsections were discussed by Dean E. H. Flath (F '43) of the North Texas Section, J. D. Hershey, and A. J. Hendry. The subject of Section operating committees was discussed by W. A. Dynes (M '43) of the Dayton Section, A. J. Hendry, W. M. Allen, and R. S. Kersh (M '45) of the Houston Section.

Other Sections activities recommended as desirable were weekly luncheons, which were proposed by K. E. Stroppel of the Cincinnati Section, L. A. Goalby (A '40) of the Denver Section, and G. F. Price (M '44) of the Georgia Section; and a monthly Section news letter, which was described as especially advantageous for Sections with a scattered membership in extensive territory by L. A. Goalby.

SMALLER SECTIONS

With G. W. Bower (M '40) of the Philadelphia Section and C. S. Purnell (M '35) of the New York Section, presiding respectively as chairman and secretary, the conference of smaller Sections included delegates from the following Sections:

Alabama
Arizona
Beaumont
Columbus
Erie
Illinois Valley
Iowa
Ithaca
Louisville
Madison
Mansfield
Memphis
Montana
Muscle Shoals
Nebraska
New Mexico–West Texas
South Bend
South Carolina
South Texas
Springfield
Toledo
Tulsa
Urbana
Utah
West Virginia
Wichita
Worcester

The smaller Sections joined with the two other groups in adopting the resolution on Section prize paper competitions. The subject of prize paper competitions was discussed by W. E. Boruh (A '42) of the Toledo Section and R. D. Finnell (A '38) of the Wichita Section.

In the discussion on technical groups which was led by N. L. Platt (A '43) of the Ithaca Section, C. D. Higleyman (A '41) of the South Bend Section, E. W. Stone (M '37) of the Illinois Valley Section, and L. F. Rylander (M '37) of the Tulsa Section, it was concluded that audience participation in discussion was a better measure of the success of a technical group than mere attendance figures.

The connection between increased Section activities and increased membership and attendance at meetings was strikingly indicated by the experiences of the Alabama Section described by C. F. Sittloh (A '39).

Electronics Courses Are Subject of Conference

"Electronics in the Electrical Engineering Curricula" was the subject of a special conference held during the Detroit summer convention, sponsored jointly by the AIEE committees on electronics and education. The conference was held Monday, June 24, at the Hotel Statler. Professor H. W. Bibber (M '30) chairman of the AIEE committee on education, acted as chairman of the conference, and prepared the following notes covering its high lights.

In opening the conference, the chairman recalled the situation of 15 years ago when a few colleges had just begun giving electronics courses. Text material was inadequate, laboratory experiments were primitive, and the courses were definitely separate parts of the curricula. Today these early difficulties with the teaching of electron-tube characteristics and their use in rectifiers, amplifiers, oscillators, and modulators have disappeared. At present the unsolved question is what to teach through lectures and laboratory regarding microwave phenomena and the performance of wave guides.

Chairman Bibber observed that the presentation of ultrahigh frequency techniques to students had been well developed in a few institutions since 1942, but that the committees sponsoring the conference felt that an exhibit of up-to-date small-scale equipment, such as most colleges could use, would be appreciated by many teachers who were present at the convention. He admitted communications into the broad interpretation of the word "electronics" in the title of the conference.

Both elementary and advanced levels were treated in the two demonstration lectures:

"The Qualitative Demonstration of Microwave Phenomena Using Simple Equipment," by W. C. White (M '30) of the Schenectady Research Laboratory of the General Electric Company.

"Wave Guide Equipment With Interchangeable Terminations and Means for Quantitative Measurements," by Professor F. W. Smith (M '44) of Lafayette College.

Mr. White's demonstration had several humorous twists. For example, he showed the interception by his body of a microwave beam that apparently was coming out of a wall of the room. The mystery was cleared up when it developed that there was a small microwave transmitter concealed in a closet. The transmitter projected a strong beam through a six-inch brick wall. Another experiment showed the magazine, *New Yorker*, to be transparent to microwaves, while *Electrical Engineering* blocked them almost completely, though there seemed little difference in thickness. It then was revealed that a sheet of tinfoil between the pages of the latter might have had as much to do with blocking the wave beam as the heavier reading matter contained therein. Mr. White performed with microwaves almost all the experiments which can be done with visible radiation.

In a relatively few minutes Professor Smith showed an extensive series of experi-

Electrical Contracting photo

Recipients of the 1945 AIEE prize paper awards are shown after presentation of the awards at the summer convention in Detroit. Left to right in the back row are: James De Kiep (M '43) of the Westinghouse Electric Corporation; G. W. Scott, Jr. (M '45) of the Armstrong Cork Company; and C. E. Warren (A '41) of the Westinghouse Electric Corporation. In the front row are: G. L. Moses (M '44) of the Westinghouse Electric Corporation; Aram Boyajian (F '26) of the General Electric Company; G. D. McCann (M '44) of the Westinghouse Electric Corporation; and L. R. Hill of the Westinghouse Electric Corporation

ments on wave guides, made possible by the means he had devised for the rapid and convenient interchange of parts of his equipment. The readings of a meter were projected on a screen, so that quantitative measurements were indicated. Both rectangular and circular guides were demonstrated, with sketches of the modes of propagation being shown on charts. Several different terminations for the guide were used, and the effect on "standing-wave ratio" was indicated clearly by meter readings. The electric field probe and the loop probe for magnetic fields both were employed to show the nature of the field pattern present in the guides.

In the discussion period following the demonstrations, the desirability of regarding the equipment which had been shown as a regular part of each school's apparatus, and not as something novel or special was emphasized. Microwave phenomena should be regarded as an extension of the study of radiation in physics, and the wave guide as the latest addition to power transmission theory, it was suggested. If students were taught that power at low frequencies really was transmitted through the *space* surrounding the wires or an ordinary overhead line, rather than *in the wires*, the flow of power through the space inside a wave guide would not be so difficult for them to grasp. This thought led to an appeal for the teaching of a greater amount of field theory to all electrical engineers.

How time can be secured for the presentation of recent developments in electronics and communication was a question of concern to many of the audience. The congestion in present electrical engineering curricula is such that new material cannot be added without something being dropped. With the setting aside of 20 per cent of the available hours of the curriculum for humanistic–social studies, and the need for every engineer to study mechanics and thermodynamics, it seemed that greater efficiency in presenting course subject matter was the first answer, with graduate study for the technically gifted student becoming more common, a second answer.

A study of the newer developments in the microwave field for all staff members of departments of electrical engineering throughout the country was suggested as desirable, so that the ideas involved might infiltrate to the students through as many different courses as possible. There seemed to be a definite sentiment against localizing the instruction in microwaves and wave guides in a course entitled "Ultrahigh Frequency Techniques," as was done in many wartime curricula. Nor was there advocacy of a communications curriculum starting in the freshman or sophomore year. Rather, there was a distinct emphasis on the unity which, it was urged, can and should exist in all electrical engineering curricula, where a definite effort to teach fundamentals basic to all later specialties is made, and little attention is paid to the short-sighted demands of many students these days for a narrow specialization in electronics and radio.

The meeting closed on a note stressing the curriculum as a means of preparing the student for life, along with the extracurricular activities of a school. Electronics should be an integral part of the physics and usual electrical engineering courses rather than be separated out entirely into discrete course work. The order of importance of the aims of any curriculum, it was asserted, should be: first, the development of the student as an *individual* and a citizen; second, his preparation as an *engineer* broadly conceived; and third, his specialization as an *electrical* engineer.

Local Councils Reported As Important Section Activity

With local councils of engineering and technical societies now active in some 45 metropolitan areas throughout the United States, this local joint activity rapidly is assuming an ever more important place in AIEE Section affairs, as it provides an effective medium, or meeting ground, for joint consideration and action on problems of common interest by the diverse elements of the technical and professional engineering field. In recognition of the increasing importance of this activity, the AIEE Sections committee arranged for a separate conference at the Detroit summer convention to provide an opportunity for the discussion of Section activities in relation to such joint enterprise. This conference was heavily attended, not only by Section delegates, but also by officers and other interested members of the Institute.

The conference provided opportunity for a review of the organization and operation of local councils, with particular emphasis on the active part that AIEE Sections have taken in this work. The three general types of local council organizations were described and discussed. Not only was this interchange of information valuable to those Sections already participating, but also it is expected to be especially useful to Sections needing assistance in expanding the activities of existing councils or in forming councils where they do not exist.

This conference was held Wednesday afternoon, June 26, 1946, at the Hotel Statler in Detroit, as a part of the summer convention program of the AIEE Sections committee. G. W. Bower (M '40) chairman of the AIEE Sections committee, presided, and A. C. Muir (M '39) served as secretary.

In opening the meeting Chairman Bower noted the widespread interest in local councils, there now being 45 such councils in active operation. He declared that "in most cases not only the AIEE Sections but also individual AIEE members have been very active in the work of these councils. This activity has been encouraged by the Sections committee. The continued growth of the councils and the expansion of their activities is factual proof that they are filling a need for co-operative efforts of all engineers in civic, legislative, and other similar broad activities of the engineering profession. The organization of these local councils has not followed a single pattern, and it is not really essential that they should."

E. B. Hansen (M '36) chairman of the Seattle Section presented a comprehensive report, written by R. E. Kistler (M '30), president of the Puget Sound Council of Engineering and Technical Societies, covering the organization and operation of local councils.

A. L. Duna (M '42) chairman of the Worcester Section, briefly described the operation of the Worcester Engineering Society.

F. R. Temple (M '21) Michigan Section representative on the Affiliated Council of the Engineering Society of Detroit, reported on that council.

J. C. Strasbourger (M '40) chairman of the Cleveland Section, outlined the organization and operation of the Cleveland Technical Societies Council.

T. M. Linville (M '34) member of the Sections committee, described the Schenectady Engineering Council; and L. R. Janes (M '29) chairman of the Chicago Section, described the three councils which are in operation in the Chicago area.

E. W. Morris (M '35) chairman of the Los Angeles Section, reported on the work of the Los Angeles Engineering Council.

C. M. Lytle (M '42) chairman of the Kansas City Section, outlined the organization and operation of the technical societies council of the Kansas City area.

R. E. Stroppel (A '34) chairman of the Cincinnati Section, described the operation of the Cincinnati Engineering Societies.

P. L. Alger (F '30) AIEE director, pointed out that local councils can increase their usefulness by engaging in civic projects within their metropolitan areas.

E. S. Lee (F '30) chairman of the Engineers Council for Professional Development, reported on the work of ECPD, stating that local councils can be of enormous help in furthering its progress, as outlined in the bulletin, "Will You Help?"

S. C. Leibing (M '36) chairman of the Central Indiana Section, enumerated the elements of successful council operation as a guide for councils in the future, using the organization of the Indianapolis Technical Societies Council as a background.

F. E. Sanford (M '34) until recently a very active leader in the local council activities of the Cincinnati Section, speaking for the local council of the future, stressed the point that the primary purpose of a local council is to be of service to the members of the member organizations, and that the first job of such a council is to issue a local weekly announcement to tell all members what all societies are doing. He predicted that some national organization would evolve, and that the local councils are the first step in this evolution.

The discussion at the meeting indicated that local councils are developing rapidly and have been very successful wherever they have been started. They seem to be the first step toward unification of the engineering profession, and have increased immeasurably the co-operation between local sections of the engineering technical societies. It is significant that in all cases reported the local AIEE Sections and members have been active in the formation of and the work of the local councils. In many cases the AIEE was the dominant factor.

Student Activities Discussed at Conference

A conference on student activities, under the chairmanship of E. W. O'Brien (M '37) of the Atlanta Section chairman AIEE committee on Student Branches, was held Thursday morning, June 27, 1946, as a part of the summer convention program in Detroit, Mich. The following highlights of this conference were reported for *Electrical Engineering* by E. M. Strong (M '40) of the Ithaca Section.

The agenda for the conference covered the following points:

1. Report of subcommittee on joint Student Branches.
2. District conferences on student activities.
3. Prizes.
4. Branch activities of interest to veterans.
5. Expiration of student membership at age under 21.

Three major projects of especial concern to the committee on Student Branches during the past year were indicated by the chairman:

1. The re-establishment of student conferences, separately, or in conjunction with District meetings where possible.
2. Revision of the booklet, "The Electrical Engineer."
3. The development of joint Student Branches.

JOINT STUDENT BRANCHES

Chairman O'Brien reviewed his action of last fall leading to a tentative approval in principle by the board of directors at the 1946 winter convention of a proposal providing for reciprocal recognition of student membership in the several recognized engineering societies. Mr. O'Brien then called upon Professor J. F. Calvert (F '45) of Northwestern University for report of a subcommittee appointed to expedite co-operation among the Student Branches of the several engineering societies in their local activity. Professor Calvert reported a recommendation which embraced two items:

1. A proposal for specific change in the wording of Section 64 of the AIEE bylaws, to authorize and implement the proposed joint Student Branches.
2. Additional procedure to expedite the proposed program of joint Student Branches beginning in the fall of 1946.

In the prolonged ensuing discussion, Chairman G. W. Bower (M '40) of the AIEE Sections committee seriously questioned the ultimate effect of the joint Student Branch proposal on AIEE activity, identity, and membership. The conference group took action, however, endorsing the proposal and transmitting it to the board of directors, then in session, for consideration and action.

Discussion clarified one important point: That the proposed program of joint Student Branches is not in any way mandatory, but is intended to be permissive only to enable such joint activities to be undertaken entirely on the basis of local option.

GENERAL DISCUSSION

There was brief discussion, but no action, on the subject of prizes.

Chairman J. H. Pilkington (M '34) of the New York Section described that Section's very active program of special counseling service for returning veterans. The report stimulated considerable interest, and brought suggestions that the New York Section prepare a descriptive report covering its project for publication (page 410 of this issue).

Favorable action was taken by the conference in support of a proposal to recommend to the board of directors that continuance of Student membership status be extended to graduates, effective until those graduates become 21 years of age.

Welding Conference Presents Popular Papers

Approximately 50 people filled the Ivory Room of the Hotel Statler in Detroit for the conference on arc welding held at 2 p.m., June 26. Among the audience were a number of designing engineers representing the electric welding industry and representatives of a half dozen power companies, as well as representatives from the Rural Electrification Administration, the American Welding Society, and the United States Bureau of Ships.

Exceptional interest was displayed in the papers, "Influence of Magnetic Materials on the Welding Characteristics of Resistance Welding Machines" and "Voltage Change Due to Resistance Welding Loads." The first-mentioned paper described how for the first time the effect of the introduction of magnetic materials into the throat of a resistance welding machine could be predetermined within limits. The effect of the introduction of such materials with reference to power factor also was given. Discussion was halted only by adjournment of the conference.

Because of the evident interest among those present in the question of power supply, it was decided to hold a conference on that subject at the 1947 winter convention. C. I. MacGuffie (M '43) presided. Mr. MacGuffie and G. W. Garman (M '43) chairman of the electric welding committee, prepared the foregoing notes for *Electrical Engineering.*

Section–Branch Co-operation Considered at Joint Conference

Ways and means of developing more effective co-operation between AIEE Sections and Student Branches were discussed extensively at a summer convention conference held Thursday, June 27, and sponsored jointly by the AIEE committees on Student Branches and Sections. This conference was presided over by Professor V. P. Hessler (F '43) of the University of Kansas (Kansas City Section) who prepared the following notes for *Electrical Engineering.* The program for the conference, as followed by Professor Hessler was:

1. Basic opportunities of Section–Branch co-operation, by Chairman E. W. O'Brien (M '37) of the AIEE committee on Student Branches.
2. The plan of Section–Branch co-operation, by Chairman G. W. Bower (M '40) of the AIEE Sections committee.
3. Typical examples of profitable Section–Branch co-operation.
5. A look into the future as a result of Section–Branch co-operation, by Past Vice-President Everett S. Lee (F '30) of the Schenectady Section, chairman, Engineers Council for Professional Development.

The conference group included Section delegates, chairmen of District committees on student activities, Student Branch counselors, and others.

In his opening address, Chairman Hessler pointed out that, since the schools are returning to more normal operation, now is the right time to consider Section–Branch co-operation.

E. W. O'Brien recommended a well thought out plan for Sections and Student Branches to provide help to the young engineers just graduated from college. This would benefit not only the students, but also the older members participating in it.

G. W. Bower outlined the 14 methods which make up the plan for co-operation between AIEE Sections and Student Branches, which is a joint activity of the Sections committee and the committee on Student Branches. Mr. Bower pointed out that many Sections now are following one or more of these methods, but no Section is using all of them. The percentage of new AIEE members coming from Student membership is now 40 to 50 per cent and should be increased, according to Mr. Bower, who disclosed that 49 Sections did not report having a student activities committee at the end of last year.

C. M. Lytle (M '42) chairman of the Kansas City Section, reported that the Kansas City Section followed a number of the items in the plan of co-operation and that the Section held meetings at the Student Branches. The Section also has been active in vocational guidance.

J. R. Jarvis (A '40) chairman of the Utah Section, reported active co-operation with Student Branches. The Student Branches frequently provide the program for the annual dinner dance of the Section. Once each year the Section has a joint meeting with the Student Branches.

C. K. Haspel (M '31) chairman of the Vancouver Section, outlined the Vancouver Section's methods of co-operation with the Student Branches.

E. W. Schilling (F '44) chairman, District committee on student activities, District 9, reported that the Student Branch at Bozeman, Mont., comes to the Section meetings at Butte, Mont.

J. H. Pilkington (M '34) chairman of the New York Section, stated that 50 of the Section's members act as counselors at the conferences held by the Section's veteran committee. The committee has held 28 weekly conferences since December, and has counseled 750 veterans (page 410 of this issue).

H. W. Bibber (M '30) chairman of the committee on education, recommended that every effort should be made to get the students in touch with the world right at the start of their engineering education instead of waiting until commencement.

G. Strosberg, Student Member, advised that the American Society of Mechanical Engineers had issued an invitation to all of the student members of ASME at the universities to help out at the ASME convention in Detroit early in June. The Student Members of AIEE were disappointed that they did not receive a similar invitation from AIEE to help out at its convention.

Doctor Abe Tilles (M '46) chairman of the San Francisco Section, outlined the methods used by the San Francisco Section for co-operation with the Student Branches. He pointed out that not only should there be a real desire on the part of the Section and the Branches to co-operate, but that they should plan and execute a program to this end.

W. C. Osterbrock (M '41) of the Cincinnati Section reported that the Cincinnati Section has a subcommittee on student activities. Selected senior students present theses at the joint meeting with the Branches, which often includes members from other societies.

E. S. Lee predicted a glowing future for Section–Branch co-operation, which included: 100 per cent of Student Members coming into AIEE; an understanding of the profession by the student; and, an impress of the engineer on the school.

Technical Sessions Sponsored by Committee on Safety

A well-attended technical session sponsored by the AIEE committee on safety was held June 24 at 2 p.m. in the English Room of the Hotel Statler, Detroit. Through the presentation of three papers, the committee directed attention to aspects of accident prevention of concern to the electrical engineer. L. F. Adams (F '42) presided and W. R. Smith (F '30) supplied the following notes on the session.

Progress in the development of electric equipment and of commercial devices using electric energy has shown the necessity for a more extensive knowledge of the effects of electric shock, particularly with regard to maximum currents that human beings may be expected to withstand without serious consequences. Professor C. F. Dalziel (M '39) of the University of California, in his paper, "Dangerous Electric Currents," extended his previous work on "let-go currents" to discuss lethal currents and their accompanying physiological effects. His paper interprets the data of an earlier AIEE paper and suggests threshold current values likely to produce instantaneous electrocution in 1/2 per cent of a large group of normal men.

A conference paper prepared by R. L. Lloyd (A '37) of the National Bureau of Standards and M. M. Brandon (F '44) Underwriters Laboratories, Inc., and presented by the latter, dealt with the fundamental aspects of shock hazards of low voltage and emphasized the importance of education to promote a better understanding of the correct use of ordinary commercial and household appliances, especially those of the portable type. Whereas the number of electrical fatalities from low voltage which occur each year is so small as to be statistically insignificant in relation to other causes of death in homes and industrial establishments, even these few cases cannot be ignored, and their further reduction depends upon proper use of approved equipment on circuits complying with the requirements of the National Electrical Code.

The wide increase in the past several years of the use of X rays and gamma rays from radioactive materials for the purpose of nondestructive inspection of industrial products has made important a proper understanding on the part of users of the fact that radiations may injure seriously workers who are inadequately protected. In a paper entitled "Silent Invisible Industrial Hazard," S. Reid Warren, Jr., associate professor of electrical engineering at the Moore School of Electrical Engineering, University of Pennsylvania, described the properties of these rays, outlined the fundamental principles underlying protection of workers, and suggested practical methods of protection which have been devised and tested in industry.

Recorders Described At Conference on Instruments

A conference on electronic instruments held at 2 p.m., June 24, in the Bagley Room of the Hotel Statler with W. R. Clark (M '44) presiding drew an attendance of approximately 150 persons. Six papers were presented dealing with electronic recorders for potentiometric and bridge-type instruments. In his opening remarks Mr. Clark briefly recounted the history of electronic recorder development.

Papers by A. J. Hornfeck (M '43) of the Bailey Meter Company and V. L. Parsegian of C. J. Tagliabue Company brought forth a number of discussions. Mr. Hornfeck discussed in detail the operation of the 2-phase motor-driven slide-wire in the Bailey electronic recorder, for which one phase is supplied by the line. The other is supplied by the output of an amplifier which amplifies the unbalanced voltage of the potentiometer or bridge sufficiently to drive the slide-wire to a balanced position. For d-c potentiometer measurements, a converter is used. In the system described by Mr. Parsegian, a mirror galvanometer detected the unbalance of the potentiometer. Light reflected from the mirror was picked up by photoelectric cells which controlled the direction of rotation of the slide-wire circuit. Special circuits were used to obtain proper damping even at high speed operation.

A more detailed consideration of "D-C to A-C Conversion Systems" was given by W. P. Wills (M '42) of the Brown Instrument Company. Mr. Wills' treatment of the subject covered reasons for converting d-c unbalance of the potentiometer circuit to alternating current, the methods used, the history of this development, and the problems encountered, the life span of the converters, the contact potential problem, and the a-c pickup.

"The Input Transformer Problem" was presented by A. J. Williams, Jr. (M '45) of the Leeds and Northrup Company. It dealt with the problem of shielding transformers, so that they can be used at the lower power levels required for input transformers for electronic recorder amplifiers. Electrostatic and magnetic shielding methods were explained, and improvements in the construction and materials for the shields were described.

A recorder which employs a capacitor operated by a solenoid to balance an a-c bridge was described in a paper, "Process Variables Made Available by Electronic Methods for Industrial Measurements," written by D. H. Fuller of the Foxboro Company. High speed operation without overshooting is obtained with this instrument. For temperature measurements, the limiting factor is the speed of response of the resistance thermometer. A working model of the recorder was demonstrated after the meeting adjourned.

Sweep balance recorders in which the slide-wire is not driven to a balance position were introduced by George Keinath (M '37) and R. K. Hellman (M '45) of the Great American Industries, Inc. A stylus is continuously and smoothly moved across the chart. The slide-wire contact of the potentiometer or bridge circuit also moves with the stylus, and, when the contact passes over the balance position of the slide-wire, a spark discharge occurs from the stylus to the chart driving-roll, thus making a record of the balance position. Multiple point recorders also were described in detail.

Technical Committees Meet at Convention

Chairmen of the various technical committee meetings and conferences held during the recent summer convention in Detroit were invited to submit for news publication in *Electrical Engineering* memoranda covering any points of their meetings considered to be of some general interest and value to the AIEE membership. Out of that group, the following were received.

CARBON BRUSHES

The following résumé of the June 27 meeting of the subcommittee on carbon brushes was reported by Professor V. P. Hessler (F '43) of the Kansas City Section.

The meeting started at 9:30 a.m. with all but four of the members present and with several additional interested members in attendance. Ed Kaplan represented the carbon section of National Electrical Manufacturers Association and served as well as a member of the AIEE committee.

An outline of the major items which eventually should appear in the brush test code first was discussed. These items then were divided into two groups, first those in which technical progress warranted writing of a preliminary code and, second, those upon which further research and development was required before the code statement could be commenced. The items of the first group were assigned to various members of the committee for writing. This material will be assembled by the chairman and presented to the group at a meeting in January. The items of the second group also were assigned to various members, but it is not expected that this work will progress so rapidly.

It is the intention of the committee to prepare a preliminary code of those items upon which the industry can agree at present and then to add additional much-needed items as rapidly as possible.

The carbon brush committee also hopes to join with the d-c machine committee in a session at the January meeting.

METALLIC RECTIFIERS

The metallic rectifier subcommittee held an all-day session Tuesday, June 25, and met again on Wednesday afternoon. On Thursday morning it joined the power converter group to discuss common problems. The committee approved a list of standard definitions and a test code, copies of which now will be distributed in due course with the object of obtaining maximum comments from the general membership. These projects eventually will be referred through the Standards committee to the American Standards Association.

Plans for an afternoon session on metallic rectifiers, to be held during the 1947 winter meeting, also were discussed. It is expected that ten or more papers will be available for selection for that session.

These notes were furnished by E. A. Harty (M '36) secretary of the committee, for L. O. Grondahl (M '42) chairman.

POWER GENERATION

Disposal of a number of subcommittee reports chiefly occupied a luncheon meeting of the committee on power generation held June 27 in the Book-Cadillac Hotel. A. J. Krupy (M '33) presided.

M. J. Steinberg (M '32) of the joint committee on prime mover speed governing specifications reported that the committee is reviewing a specification for governing of steam turbines under 10,000 kw. A specification covering speed governing and pressure regulation is completed and will be distributed for comment in the near future. The draft of a specification for hydroelectric units is under preparation.

It was announced by A. D. Caskey (M '45) of the subcommittee on grounding practices that replies to its questionnaire are being received and a summary of their contents is being made.

After a discussion on whether a report on the standardization of excitation systems should be started now or deferred until after the educational process now under way is completed, it was voted to activate a subcommittee on standardization of excitation systems. It was agreed to continue the present subcommittee on excitation systems for the purpose of procuring papers.

A widespread interest in the application of the theory of probability to problems in system planning was noted by Mr. Steinberg, who thereupon was appointed to investigate and report on the potentialities of papers on this subject for a future meeting.

Sessions on hydroelectric systems and on interconnected systems are being planned tentatively for the 1947 winter meeting, it was announced. Notes on the meeting were submitted by Mr. Steinberg, secretary of the committee on power generation.

TRANSFORMER DIELECTRIC TESTS

The initial meeting of the working group on revision of dielectric tests, of the AIEE transformer subcommittee, was held June 26 for the purpose of defining the scope of its project. It was decided that the principal objective of the work would be the development of a set of tests which will assure that the assigned insulation levels have been met through proper design, and not through good workmanship alone.

The nature of the tests required, and the degree to which present tests meet the requirements, will be subjected to critical examination in the hope that simplification or better co-ordination can be achieved. Service requirements will be reviewed within the framework of the established basic insulation levels.

The foregoing notes were furnished by E. R. Whitehead (F '45).

Future Meeting Plans Include Midwest Meeting

A change in the number of yearly AIEE meetings was approved by the board of directors at its meeting June 27 in the Hotel Statler, Detroit, Mich. The locations of the meetings for the coming year also were settled by the directors.

It was decided that there will be four national meetings of the Institute each year, instead of the present three. The additional meeting will be known as the Midwest meeting. Section 27 of the bylaws was amended to read:

> Section 27. There shall be four general meetings of the Institute each year, namely, the winter meeting, the summer meeting, the Midwest meeting, the Pacific Coast meeting, with such additional meetings as may be authorized from time to time by the board of directors. The board of directors shall determine the location and dates of all Institute meetings and, in case of public emergency, may postpone or omit any such meetings.

In accordance with recommendations submitted by the committee on planning and co-ordination and in acceptance of invitations received from the Sections involved, the following meetings were authorized:

1947 summer meeting, Montreal, Quebec, Canada, June 9–13.

1947 Midwest meeting, Chicago, Ill., exact dates in October to be determined later.

1948 winter meeting, Pittsburgh, Pa., January 26–30.

1948 summer meeting, Mexico City, Mexico, exact dates to be determined later.

The location of the 1947 Pacific Coast meeting still is under consideration. The board approved the dates, September 23–25, 1947, for the previously authorized Middle Eastern District meeting to be held in Dayton, Ohio.

No More "Conventions" for Institute. At its recent meeting in Detroit during the summer convention, the board of directors voted to drop the word "convention" in favor of the word "meeting" in designating the general meetings of the Institute. The first meeting affected by the change is the Pacific Coast meeting in Seattle, Wash., August 27–30, 1946.

Seventh Report Submitted on AIEE Aeronautical Standards

The air transportation committee, under the chairmanship of J. D. Miner, Jr. (M '42) has several subcommittees, each handling standardization activities, and this report summarizes the results to date. There is much work yet to be done, and the committee is very anxious to obtain some additional assistance from the aircraft industry in carrying on its standardization projects. Reports of the subcommittees follow.

Aircraft Electric Systems [Chairman, R. H. Kaufmann (M '41)]. The status of this work remains the same as it was in April. A comprehensive outline has been prepared covering the fundamental electrical problems involved in aircraft electric systems, characteristic data, procedures for analysis of system performance, and application practices. Data for a number of the sections have been compiled in preliminary form from various sources, and it is proposed to issue a report in preliminary form as soon as information is obtained covering the other sections.

Aircraft Electric Rotating Machinery [Chairman, M. L. Schmidt (M '43)]. A test code for "Aircraft D-C Machines" has been prepared, approved by the subcommittee, and has been sent to the air transportation committee for letter ballot approval as a proposed standard as of July 2.

Aircraft Wire and Cable (Chairman, W. S. Hay). As a result of extensive tests and studies, data have been obtained suitable for a preliminary test code for aircraft cables, and this is to be made available for committee consideration. AIEE paper 46-145, "Short-Time Current Ratings for Aircraft Wire and Cable," by B. W. Jones and J. A. Scott, presented at the AIEE summer convention, gives a method of evaluation of certain types of aircraft cables.

These data will be combined with other cable information in the afore-mentioned test code. This subcommittee is being discontinued, and the cable activities are to be incorporated into the subcommittee on control and protective devices, which will prepare a test code.

Aircraft Electric Control and Protective Devices [Chairman, R. A. Millermaster (M '34)]. This group has been awaiting the results of the work of some of the other groups. It is planned, in consolidating with the cable group, that the scope will be expanded to include cables as well as protective equipment, and this should be a very effective handling method, as the problems are allied closely. This added responsibility will necessitate reorganizing the subcommittee somewhat.

Aircraft Carbon Brushes [Chairman, V. P. Hessler (F '43)]. The major items which should be included in an aircraft machine carbon brush test code have been listed and divided into two groups: (1) those in which the technical progress is such as to warrant preparation of a preliminary test code, and (2) those items on which further research and development work will be required before a suitable test code can be prepared. The items of group 1 have been assigned for preparation, and it is expected that this material will be available for preliminary discussion at a meeting in January 1947. Preliminary copies of the proposed test code will be circulated to the industry for consideration as soon as available. The work of the carbon brush group is being consolidated with that of the aircraft d-c machinery subcommittee.

Basic Principles of Aircraft Altitude Rating [Chairman, W. E. Pakala (M '45)]. This subcommittee is just getting organized and expects to develop a standard covering the basic principles of altitude rating of aircraft electric machinery. This group contemplates studying the effect of temperature on insulation life, air density for flight ambient, blast tube cooling, methods of measurement and test, and standard methods of indicating rating as a function of altitude. This subcommittee is particularly in need of members who are associated with aircraft users. Suggestions concerning such membership will be welcomed by Mr. Pakala (Westinghouse Electric Corporation, East Pittsburgh, Pa.).

Aircraft D-C Apparatus Voltage Rating (AIEE 700). The results of the letter ballot concerning this Standard which has been out on a trial basis for over a year were inconclusive. It is planned to recircularize the industry and possibly to continue for an additional trial period with the proposed Standard 700 modified editorially.

Collaboration With SAE, NASC, and NEMA. It will be recalled that the AIEE aircraft electric standardization activities are being carried on co-operatively with other aircraft standardization work by other organizations such as the Society of Automotive Engineers, the National Aircraft Standards Committee, and the National Electrical Manufacturers Association. These other organizations are looking to the AIEE particularly for assistance in the formulation of fundamental electrical standards, including methods of rating and performance characteristics of electric equipment and devices, test codes and methods of demonstrating specified performance, determination of fundamental characteristics of aircraft electric systems and methods of calculation.

SAE Committee A-2—Aircraft Electric Equipment. This committee at a recent meeting reaffirmed its request to AIEE for assistance and also has requested information concerning additional projects. The members of the AIEE air transportation committee plan to schedule future meetings immediately adjacent to or concurrent with the meetings of SAE committee A-2 in view of the board mutual interest in these standardization activities and the large number of individuals who are interested in both groups.

Mailing Date Changed for Electrical Engineering

Hereafter, members and subscribers should receive their copies of *Electrical Engineering* by about the first of the month of issue, instead of three weeks or so later, as has been the unsatisfactory average during recent years.

Originally contracted for mailing between the 3d and the 5th of the month of issue, copies came to be mailed as late as the 23d, under the adverse influence of wartime and other conditions affecting the printing plant.

This seriously impaired the timeliness of material accepted under contract closing dates designed for the earlier mailing. Failure of consistent efforts during the past year to regain the original mailing dates left no alternative but to accept the later mailing dates, and to change the date designation of the issue and alter the contract closing dates accordingly.

Thus, effective with the October issue, the contract mailing dates will be the 20th–22d of the month, and members should receive their copies thereafter as promptly as the United States mails can carry them from the printing plant in Easton, Pa.

To effect this change with minimum lost motion and production confusion, and to avoid the impossible task of publishing two separate issues in the production time of one, the current August issue has been consolidated with the September issue.

Board of Directors Meeting Held in Detroit

The regular meeting of the AIEE board of directors was held in Detroit, Mich., June 27, 1946, during the summer convention. The morning session was held in the Hotel Statler and the luncheon and afternoon session in the Book Cadillac Hotel.

The directors appropriated $875 to cover the Institute's share of the cost of issuing the proposed "Fifteenth Anniversary Brochure" of the Engineers' Council for Professional Development; increased the official allowance for traveling expenses from nine cents per mile one way to eleven cents, effective August 1, 1946; and authorized the transfer of $40,000 from the general funds to the reserve capital fund for investment. Chairman W. R. Smith of the finance committee reported monthly disbursements of $47,136.94 in May, and $33,921.18 in June.

Mr. Smith reported that it was proposed to send a general letter to the members in Allied countries who became delinquent in the payment of dues during the war and were placed on the inactive list, suggesting that they become reinstated to active membership during the present fiscal year, without formality. It is proposed to send a similar letter to the members who were in military service and are still on the inactive membership list after they have had adequate time to communicate with headquarters. However, requests for restoration to active membership are received daily.

Meeting plans discussed and approved by the directors will be found on page 407.

After a further discussion of the possibility of an electrical exhibit being held concurrently with the winter meeting, the directors decided that no change should be made in Section 29 of the bylaws, and voted to clarify its action at the May meeting to read as follows:

> The board of directors of the AIEE sees no objection to the use by an exhibiting agency of the expression "To be held concurrently with an AIEE meeting."

The steps previously taken for co-operation with the 1946 National Electronics Conference were reviewed, and the committee on planning and co-ordination was requested to report upon the question of continuing official co-operation.

Section 65 of the bylaws was amended to include the new standing committee on registration of engineers, and a new Section 73 was adopted to define the scope of the committee, reading as follows:

> Section 73. The committee on registration of engineers shall consist of 9 members, appointed by the president. This committee shall keep informed on registration laws and amendments thereto, and shall co-operate with other societies and various examining boards. The committee shall submit reports and recommendations regarding registration to the board of directors for such Institute action as appears to be in the best interests of the engineering profession and the community.

In accordance with the directors request at its May meeting, the committee on planning and co-ordination had given consideration to the possibility of greater use of the District organizations and to methods of planning visits to Sections to make more effective use of the president's time. The committee recommended and the directors adopted the following resolutions:

> RESOLVED that it is the sense of the board of directors that:
>
> (*a*). Attendance of the president at general meetings,

District meetings, meetings of the Engineers Joint Council, and other intersociety obligations should take precedence over visits to Sections.

(*b*). The District vice-president shall be made fully responsible for the visits to local Sections. It shall be the duty of the District vice-president to receive all requests for Institute officer speakers and to co-ordinate these requests for all meetings in his area. If the District vice-president is not to make the visits personally, he may be free to arrange for other officers, or members of the headquarters staff, to be the official delegate when this appears to be the most effective method.

(*c*). At each summer meeting, it shall be the duty of the secretary of the Institute to call a special meeting of the hold-over and incoming vice-presidents at which they shall be informed of their duties in co-ordinating the work in the Districts and instructing Sections on the method of obtaining officer speakers.

(*d*). When the formal visits to Sections are made by either the District vice-president or by some other officer, the same expense allowance will be paid by the Institute as if the visits were all made by the vice-president.

(*e*). The committee on planning and co-ordination is requested to continue its study of the possibility of greater use of the District organizations.

RESOLVED, that the attention of the Districts be called to the merits of building the program of a District meeting around a dominant theme based on a subject of timely interest and particularly suitable to the location in which the meeting is to be held; that when this type of program is contemplated the committee in charge of a District meeting should at the earliest opportunity notify the secretary of the technical program committee in order to take advantage of the assistance which is available to them in the appropriate technical committee or committees, the technical program committee, and the headquarters staff, and that such an occasion might well afford a favorable opportunity for a meeting of the interested technical committee or committees. It is to be understood that a District meeting is the responsibility of the District concerned and hence that the initiative in planning and arranging for a meeting of the type suggested lies with the District executive committee.

The committee on collective bargaining and related matters made the following recommendations:

1. That the publication of the "Manual on Collective Bargaining for Professional Employees" be a joint undertaking of the several societies (at present six) participating in the work of the Committee on Economic Status of the Engineer.

2. That the AIEE committee on collective bargaining and related matters continue to develop the draft of the complete manual with the understanding that the drafts of the outline, and of the several chapters, are to be submitted to the Committee on Economic Status of the Engineer for criticism as they become available.

3. That the program be changed to provide for the earliest practicable issuance of Part I of the manual as a separate publication.

The directors approved these recommendations, and also approved the publication of Part I of the manual on the basis of the outline presented by the committee.

It was reported that the United Engineering Trustees, Inc., had recently approved the appointment of a building planning committee composed of the four secretaries of the Founder Societies, or their designees, the secretary of UET, a representative of the library, and the president of UET as chairman.

The secretary of the AIEE was authorized to serve on this committee, provided this is not construed to preclude consideration of a possible new building.

At the recommendation of the Engineers Joint Council the board voted that the president of AIEE be authorized to appoint a representative to serve on a panel which would be represented at hearings on the Bloom Bill, HR 4982. EJC is opposed to the bill which would empower the State Department to engage in a broad program of dissemination of information in foreign countries, and the interchange of persons, knowledge, and skills between the United States and other countries.

President Wickenden reported that he had appointed Everett S. Lee as AIEE representative on the American committee on participation in the Sixth International Congress for Applied Mechanics.

Present at the meeting were:

President W. E. Wickenden; Past President C. A. Powel; Vice-Presidents C. B. Carpenter, M. S. Coover, J. F. Fairman, E. S. Fields, R. T. Henry, F. L. Lawton, L. M. Robertson, R. W. Warner, H. B. Wolf; Directors P. L. Alger, J. M. Flanigen, K. L. Hansen, C. M. Laffoon, C. W. Mier, S. H. Mortensen, W. B. Morton, J. R. North, D. A. Quarles, Walter C. Smith, W. R. Smith; Treasurer W. I. Slichter; Secretary H. H. Henline; and by invitation, incoming officers, J. Elmer Housley, R. F. Danner, E. W. Davis, T. G. LeClair, E. P. Yerkes; also, for a part of the meeting, M. M. de Lascurain (Mexico Section delegate), I. Melville Stein, K. B. McEachron, J. E. Hobson.

DISTRICT • • • • •

Great Lakes Meeting in Indianapolis, October 9–11, 1946

To secure better hotel facilities and to avoid conflicts of meetings the location for the Great Lakes District meeting has been shifted to Indianapolis, Ind., and the dates have been changed to October 9–11, 1946. Both the Fort Wayne Section and the Central Indiana Section will be hosts to the meeting.

An industrial type of program will be featured, and most of the papers will be conference presentations. The subjects of sessions tentatively arranged are as follows: power transmission and distribution, basic sciences, electronics, quality control, industrial measurements, communications, industrial power applications, and industrial control.

STANDARDS • • •

Pool Cathode Mercury-Arc Converters. There is now available for comment and criticism a "Report on Proposed Standard for Pool Cathode Mercury-Arc Power Converters." This report, 6, in the AIEE Standards series, was prepared under the auspices of the subcommittee on electronic power converters of the AIEE committee on electronics. Doctor C. H. Willis, chairman of the subcommittee, is also chairman of the American Standards Association Sectional Committee C34, Mercury Arc Rectifiers, to which the report will be presented for consideration. The AIEE is sponsor for C34. These Standards apply to all types of mercury-arc power converters, employing rectifying devices with mercury pool cathodes and used for power conversion purposes, including mercury-arc power rectifiers, mercury-arc power inverters, electronic frequency changers and converters used with electronic motors when these equipments employ mercury-arc rectifying devices with pool cathodes. These Standards do not apply to welding rectifiers, nor electronic power converters employing rectifying devices with thermionic cathodes. Due to the action of the rectifier, the windings of associated transformers carry currents which differ substantially from the usual sinusoidal form. These Standards, therefore, include a supplement on transformer equipment of rectifier units. Copies of the proposed Standard, which supersedes the edition of 1934, can be obtained from AIEE headquarters without charge.

Symbols for Electric Power and Control. A recently revised edition of the American Standard Z32.3 "Graphical Symbols for Electric Power and Control" is now available at 40 cents per copy with the usual 50 per cent discount on single copies to members of AIEE. This revision was approved by ASA on March 1, 1946.

Neutral Grounding Devices. A subcommittee of the AIEE committee on protective devices, under the chairmanship of J. E. Clem (F '38), has prepared a revision of the AIEE 1942 report 32 on "Neutral Grounding Devices." This revised report has been recommended by the protective devices committee for approval as an AIEE Standard. After the period required for obtaining necessary formal approval, notice of its availability will be given in *Electrical Engineering*.

Machine Tool Wiring Standards. As the result of an appeal from the AIEE Cincinnati Section that the Institute interest itself in what probably would result in the development of a recommended practice for the application of electric equipment to machine tools, the Standards committee at its meeting of June 25 took action recognizing the importance of such a project. It directed that an investigation be made of any past or current work of a similar nature and, if such is in progress, that request be made for proper representation in a further development of the project. With this object in view, the committee on industrial power applications is studying the situation with a view to later definite recommendations on action by the Institute.

Voltages Under 100. Sectional Committee C67, working under the sponsorship of the electrical Standards committee of ASA has completed work in the preparation of a proposed Standard for trial use on "Voltage Under 100." At the present time it is not known when this will be available for distribution.

Storage Batteries. The Institute, as sponsor for Sectional Committee C40, Storage

Batteries, is reorganizing that committee with a view to undertaking a revision of the American Standard for "Storage Batteries," AIEE 36, approved in 1928.

Hard Drawn Aluminum Conductors. The American Standard C11 for "Hard Drawn Aluminum Conductors" was approved in 1927. Steps now are under way to reorganize the C11 committee. When such reorganization is completed, the work of revising the Standard will be undertaken largely from the viewpoint of additions to the Standard to cover recent developments.

Definitions of Electrical Terms. Sectional Committee C42 under the sponsorship of the AIEE developed the "American Standard Definitions of Electrical Terms" approved by ASA in 1941. It also was approved as a Canadian standard in 1942. Due to pressure of war work the sectional committee has been inactive since 1942. Over 20,000 copies of C42 have been put in circulation. In the interim, however, headquarters has been in receipt of some criticisms of the approved definitions and a large number of suggested additions. Due to the long period of inactivity it has been found necessary to reorganize the sectional committee completely. This work is practically complete. As soon as a new chairman to succeed C. H. Sanderson, resigned, has been selected, the work of setting up the 18 subcommittees will be undertaken, and it should be possible to get the actual work of revision under way early in the fall.

(Left to right) J. A. Rawls (M '27) outgoing chairman of the AIEE Virginia Section, J. E. Housley (F '43) AIEE president, and C. H. Smoke (M '42) incoming chairman of the Virginia Section, at the recent annual convention of Virginia engineers, the first since 1941. The convention, a two-day affair sponsored jointly by the various engineering organizations in Virginia, was held at the Hotel Nansemond, Norfolk, Va. AIEE representatives on the meeting committee were: Llewellyn Saunders (M '32) and H. W. Evans (M '34)

SECTION • • • • • •

Well-Planned Service for Veterans Offered by New York Section

The program of weekly conferences for returning veterans instituted by the New York Section in December 1945 aroused a great deal of interest at the conference on student activities held in Detroit, June 27.

The veterans committee of the New York Section was created to advise returning veterans on their educational and employment problems in an informal way with the co-operation of the Institute of Radio Engineers and the Illuminating Engineering Society. Although so far the committee has attempted to cover only branches of electrical engineering, many mechanical engineers have attended the conferences. Subsequent interviews were arranged for these men.

The meetings scheduled for 7 p.m. each Thursday evening are publicized by bulletin board notices in termination centers, other veteran service centers, and in the Engineering Societies Personnel Service.

A diversified group of counselors usually is in attendance and to expedite counseling a brief questionnaire is filled out by the veterans, giving their war record, principal experience, and previous schooling. The nature of the committee then is explained, and the educational and employment situation is outlined in a general manner. Each man is given a list of engineering schools and curricula accredited by the Engineers' Council for Professional Development and a copy of the most recent employment bulletin of the Engineering Societies Personnel Service, Inc.

Assignments to counselor groups then are made on the basis of field of interest, though the men are encouraged to visit any of the other groups, as they wish. The counselors who have volunteered report thoroughly enjoying the experience because of the seriousness of purpose and high caliber of the veterans.

By June 13, 27 conferences had been held, and 42 different engineers had acted as counselors. The veteran attendance had varied from 8 to 50 and had totaled 705. The counselor attendance had varied from 3 to 12 and had totaled 150. The veterans have expressed gratitude for this service, and the Section has had a favorable reaction from the various service centers.

Continual Education Program Followed by New York Section

In furtherance of the efforts of the AIEE committee on education at the Detroit summer convention conference of officers, delegates, and members to stimulate greater educational activity among the Sections, the New York Section has submitted some pertinent statistics on its ventures into the educational field since 1934.

The educational work of the Section commenced in 1930, at which time a course in public speaking was offered by the power group. A course in effective speaking since has become a fixture in the Section's seasonal programs. It was not until 1934, however, that technical courses were given consistently. The custom of having the courses sponsored by technical groups, of which the New York Section has six, has continued. In many instances the courses have been sponsored co-operatively with local units of other national societies—the Institute of Radio Engineers, the Illuminating Engineering Society, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, the American Mathematical Society, the American Physical Society, and the American Society of Civil Engineers.

During the past year, courses have been organized by the power and industrial group and by the groups on communications, basic science, and illumination. The lecturers are drawn from industry and from the colleges. For recent courses, classroom facilities in Columbia University and Pratt Institute have been secured, as well as lecture rooms in the Engineering Societies Building and in a number of company properties in the New York area.

The length of the courses ranges from 18 to 3 weekly sessions, and the fees from $15 to $1 for members. A six-week course with a $3 fee is the most common arrangement. The fee usually is doubled for nonmembers, but the difference in tuition is refundable if application for membership is made within a specified time.

With ten engineering colleges in its territory, the Section carefully has avoided encroachment on academic curricula. Continuation of college work by members, especially graduate work, has been encouraged. Fifty different subjects have been covered, some so popular that they have been repeated yearly for 12 years. Typical of their kind are the following courses from the 1945–46 list: atomic engineering, applied lighting, engineering economics and practice, structural planning and design, radar, electric power utilization, transformers, rectifiers, servomechanisms, induction and dielectric heating, and cables. Courses mainly fall into two classes:

1. Review courses for men preparing for professional engineer's license examinations.
2. Information courses covering developments and review of engineering techniques.

The total enrollment through the 1945–46 season has exceeded 13,100. A breakdown of this figure indicates the distribution of interest:

1.	Electronics and related courses	4,500
2.	Review courses for licensing examinations	3,700
3.	Courses of special interest to industrial engineers	1,700
4.	Public speaking courses	500

ABSTRACTS....

TECHNICAL PAPERS previewed in this section will be presented at the AIEE Pacific Coast meeting, Seattle, Wash., August 27–30, 1946, and will be distributed in advance pamphlet form as soon as they become available. Copies may be obtained by mail from the AIEE order department, 33 West 39th Street, New York 18, N. Y., at prices indicated with the abstract; or at five cents less per copy if purchased at AIEE headquarters or at the meeting registration desk.

**Mail orders will be filled
AS PAMPHLETS BECOME AVAILABLE**

Air Transportation

46-180—Control and Protection of Aircraft Power Systems; *B. O. Austin (M '42). 15 cents.* Control and protection of aircraft d-c power systems are described pointing out the wide differences in the generator capacities of prewar and postwar transports. Consideration is given to the new wide speed generators having three to one ratios and capable of sustaining fault currents from 5,000 to 10,000 amperes at a voltage of 30 or greater. Control devices involving performance, over-voltages, and generator and cable faults are discussed. Diagrams showing the various degrees of protection are provided, together with actual photographs of the apparatus. A means of quick removal of the control panels is shown.

46-188—An Electronic Frequency Meter and Speed Regulator; *Ellis Levin (A '44). 20 cents.* An electronic frequency meter and speed regulator has been devised to measure and hold the speed of a small air or steam turbine within plus or minus one half per cent of any speed between 10,000 and 100,000 rpm. It employs a photoelectric speed pickup, a null-balance frequency measuring circuit, and an electropneumatic servomechanism. The frequency meter, of the modified "recurrent capacitor discharge" type, provides a d-c or an a-c error voltage proportional to variation of the input frequency from the desired value, with a frequency measuring accuracy in the order of one tenth per cent.

46-190—Electrical Anti-icing of Aircraft Windshields; *J. D. McCrumm (A '36). 20 cents.* The primary purpose of heating an aircraft windshield is to prevent ice formation. If, in addition, the windshield is of laminar glass and vinyl plastic construction, the resistance to bird impact may be increased substantially by maintaining a normal temperature. This paper discusses windshield thermal requirements as a function of flight environment and factors pertinent in designing a heated structure. The heat may be supplied by heated air, resistance wires embedded in the plastic, infrared radiation, or a transparent electrically conductive coating on the glass. The heated air system requires two panels and may develop excessive vinyl temperatures; however, the anti-icing ability is good, and the weight not excessive. Hot embedded wires produce serious optical distortion but offer a lightweight system. The infrared equipment is very awkward to install. The transparent coating, a very thin but durable film of low electrical resistance applied to glass, offers considerable promise as the best solution to the problem.

46-192—An Improved Azimuth Indicating System for Aircraft; *E. E. Lynch (M '35). R. A. Pfuntner. 20 cents.* Because of the violent maneuvering possibilities in modern aircraft, the usefulness of azimuth indicators in avigation depends on circumstances not existing in marine navigational applications. New problems in direction indicating instruments therefore have been introduced, such as the perplexing problem of obtaining indication after loops, rolls, and so forth. Azimuth indicating systems now used in aircraft have not given a completely satisfactory solution to such problems. This paper sketches progress from the direct reading compasses to monitored gyroscopes and concentrates on the unique problems in aircraft where space limitations, reliability, and operation at all altitudes are important.

46-193—Effects of Thermal Characteristics of Aircraft Generators on Load Analysis; *Stanley Rogers (A '43). 20 cents.* The large and complex electric systems in modern, long range aircraft have made accuracy of load analysis more important than ever before. By averaging anticipated loads over not one or two, but several different periods of time, the adequacy of proposed generators can be evaluated more precisely. The generators' overload thermal characteristics are the primary factor in determining the lengths of the different averaging periods. Overload characteristics may be determined experimentally, or may be estimated by a combination of mathematical and empirical relations, and may be represented graphically by a "permissible overload curve." Such a curve states the time for which, under specified conditions, an overload of any magnitude can be tolerated by a stated generator. Direct graphical comparison of anticipated average loads with the permissible overload curve clearly indicates the adequacy of proposed generating equipment.

46-197—150,000 Horsepower Applied to Aeronautical Research; *J. A. White (A '41). 15 cents.* This paper describes applications of electric power at the Ames Aeronautical Laboratory of the National Advisory Committee for Aeronautics. This aeronautical research laboratory at Moffett Field, Calif., has wind tunnels and accessory equipment, in operation or under construction, aggregating over 150,000 connected horsepower, with as much as 50,000 horsepower in a single drive unit. The "modified Kraemer" variable-speed drive system, an a-c variable-speed system particularly suited for large-power applications, is described, as well as other types of wind tunnel drive systems. The applications of special water-cooled motors for driving propellers on airplane models is discussed. Power is delivered to the Ames laboratory at 110,000 volts and is stepped down to 6,600 volts for the large wind tunnel drives and for distribution to buildings. Owing to the intermittent operation of wind tunnels, power dispatching is practiced in order to avoid unnecessarily high maximum demands due to occasional simultaneous operation of large wind tunnels.

Basic Sciences

46-195—The Use of Business Machines in Determining the Distribution of Load and Reactive Components in Power Line Networks; *P. D. Jennings, G. E. Quinan (F '18). 15 cents.* The object of this paper is to give a brief description of the use of punch card type of business machines in determining load and reactive component distribution in power line networks, when analyzer boards are not readily available. It is possible to determine such distribution by the solution of a set of simultaneous complex linear equations, which can be accomplished by the use of determinants. The business machines will eliminate the great amount of time and drudgery heretofore required in solving the determinants.

Communication

46-183—Application of Compandors to Telephone Circuits; *C. W. Carter, Jr. (M '39), A. C. Dickieson (M '41), D. Mitchell. 25 cents.* Prior to the war a compandor was developed for general use on broad band message circuits of the Bell System. This equipment provides power range compression at the transmitting end and power range expansion at the receiving end of a telephone channel. The resulting cross-talk and noise reductions of about 25 decibels are large enough to make useful circuits out of channels which otherwise would be unworkable. The paper considers engineering problems in the application of compandors and describes the circuit principles involved in the equipment.

46-198—Television—A Review of Present Status; *E. W. Engstrom, R. D. Kell. 15 cents.* Before the war there were four major technical problems facing the commercialization of television:

1. Radio transmitters of adequate power to cover all of the commercial broadcast channels.
2. Television broadcast networks.
3. Sufficient television camera sensitivity.
4. Larger and brighter pictures.

The present technical status of television is described. This includes a description of the solutions to the four technical prewar television problems.

Domestic and Commercial Applications

46-184—Specific Engineering Problems in Rural Electrification and Electroagriculture; *M. M. Samuels (F'24). 30 cents.* In the fields of rural electrification and electroagriculture, there are specific problems for the electrical engineer, some old, some new, some partly solved, others as yet unsolved, and still others which have not yet been definitely stated. This paper discussed representative problems in the various categories. Co-operative efforts by industrial, educational, and governmental agencies in solving specific problems are described. Problems not yet solved or not yet definitely stated are presented as a challenge to the profession. An appendix contains a list of applications of electricity for the farm.

Education

46-187—Teaching Electricity and Magnetism; *V. P. Hessler (F'43). 20 cents.* The fundamental relations of electricity and magnetism are presented in a series of experimental, defined, and derived relations and generalizations. Each succeeding relation is shown to result from derivation based on the preceeding relations or to be the result of additional experiment or definition. All relations contain the fundamental constants—permeability of free space and permittivity of free space—and thus are applicable to any unrationalized unit system. All magnetic field quantities are shown to be the result of definition. The rationalized system of relations can be formed in a similar manner by arbitrarily replacing the number 2 in the numerator of the parallel wire force equation by a 2π in the denominator.

Electric Machinery

46-189—Dielectric Strength of Station and Line Insulation to Switching Surges; *P. L. Bellaschi (F'40), L. B. Rademacher (A'45). 20 cents.* The paper reports tests conducted to determine the strength of station and line insulation to switching surges and analyzes the findings with respect to prior data in relation to the over-all insulation problem. In most cases, impulse data were secured simultaneously for comparison purposes. The switching surges developed in the tests attain durations in excess of 1,000 microseconds and voltages corresponding to five times line-to-neutral voltage on a 230-kv system, or $3^{1}/_{3}$ times on 345 kv. Tests were made on apparatus both dry and wet comprising insulators, bushings, and rod gaps. In addition, tests were conducted on oil-immersed apparatus. The switching-surge strength of station and line insulation, in most cases, is 90 to 95 per cent of the corresponding impulse. For insulation in air conforming to usual conditions, the switching-surge strength is not affected by rain or dew to a greater extent than impulse. These fundamental data should be conducive to better utilization of the insulation and of significance in connection with developments of power transmission at extra-high voltages.

Industrial Power Applications

46-194—Self-Excited Electromagnetic Drive for a Resonant Fatigue Machine; *A. R. Willson (M'35). 15 cents.* This paper describes the application of a self-synchronous vacuum tube drive to fatigue testing machines. Fatigue machines simulate the vibrating loads which result from reciprocating engines, variable air loads, and various rotating machinery which is not properly dynamically balanced. The electric drive is a solenoid operating in a polarized field similar to a loudspeaker. The exciting voltage is generated synchronously with a vibrating beam of the machine. This voltage then is amplified sufficiently to drive the actuator solenoid synchronously. This self-synchronous feature is very important, because the inherent high Q of the system amplifies some 10 to 50 watts of drive power into 2,000 to 5,000 pounds of vibrating load at frequencies from 7 to 40 cycles per second. An experimental 5,000-pound machine is described in this paper. This electric drive is comparatively low in original cost and cheaper to maintain than mechanical types previously used. The specimen load is controlled as simply as the volume on a radio receiver. A 100,000-pound fatigue machine which is nearing completion, is described briefly.

Instruments and Measurements

46-179—Fault-Current Measuring Device; *M. J. Lantz (A'43). 15 cents.* In electric power system operation, numerous problems are encountered in analyzing the results of short circuits and in the physical location of the trouble. The device described in this paper is a simple, automatic, inexpensive, and reasonably accurate piece of equipment for measuring the magnitude of fault current. The results of a number of laboratory and field tests show accuracies of the following order: maximum deviation ±12 per cent and an average deviation of ±5 per cent. The device consists of one or more coils of wire with magnetic links inserted in them. The contacts of a by-pass relay normally short-circuit the coils until approximately one cycle prior to the oil circuit breakers' interruption of current. The device is placed in the secondary winding of the current transformers and records the magnitude of the last one-half cycle of fault current prior to its interruption. The device can determine the magnitude of the fault current, the type of fault, and phases involved.

46-181—An Oscillograph for Recording Transient Recovery Voltages; *W. G. Hoover (A'34). 20 cents.* In this oscillograph, which uses a high-voltage sealed-off cathode-ray tube, the beam is swept horizontally across the fluorescent screen once for each current zero during the interruption process. Voltage across the test circuit breaker causes vertical deviations of these traces. The individual horizontal sweeps are separated by superimposing them on a slow downward drift. A series of spaced lines results, with the last and lowest line containing the recovery-voltage transient at arc extinction. Timing the high-speed horizontal sweeps is accomplished by a d-c biased saturating core tripping transformer connected to a current transformer measuring the short-circuit test current. A camera attachable to the front of the oscillograph photographs the traces on the screen and also allows simultaneous visual observation. Oscillograms obtained on high and low power interruption tests are shown.

Land Transportation

46-186—Comparisons of Railway Motive Power for Operations in the Pacific Northwest; *T. M. C. Martin (A'45). 30 cents.* This paper analyzes modern reciprocating steam, Diesel, and electric locomotives for operation in the Pacific Northwest. Physical comparisons in terms of the respective hauling abilities of different locomotives as well as economic comparisons of their operating capabilities are included. The principal conclusion reached is that, although the first cost of full electrification is greater than full Dieselization, the operating facility provided not only is capable of maximum physical accomplishment but also gives more assurance of continued satisfactory economic performance. This is true under existing price levels of Diesel oil and electric energy, and the choice of electrification is no less attractive when full consideration is given to the probable future relative prices of energy sources. In a region of extensive hydroelectric development, mainline electrification well may afford railroads a hedge against undue inflation of operating costs during the next decade or two.

Power Generation

46-178—Power System Development for Service to Hanford Plutonium Plant; *B. V. Hoard (M'36), J. R. Curtin (A'42). 20 cents.* Early in 1943 it became known that the Hanford Engineer Works load would be connected to the power system of the Bonneville Power Administration. Only after the war was won, was it learned that this plant was making plutonium for use in atomic bombs. However, initially it was known that whatever the product made, this plant would require a power supply which would have the utmost reliability. At that time many other war loads were being supplied by the BPA system, but, because of shortage of materials and labor, system additions had not kept pace with the new war loads. As a result, the system could not supply reliable service to the Hanford Engineer Works without major additions and system changes. This paper describes various interesting problems encountered, the methods used, and the changes made in the BPA system, so that the Hanford Engineer Works would have a reliable source of power supply.

46-182—Long-Distance Power Transmission as Influenced by Excitation Systems; *C. Concordia (M 37). S. B. Crary (F'45), F. J. Maginniss (A'43). 30 cents.* The object of this paper is to show how the electric loadings of long-distance transmission systems may be increased appreciably by the use of automatically controlled excitation and the proper co-ordination of apparatus characteristics. A reconsideration of this problem has been made desirable by the development of the continuously acting static type of voltage regulator and by the present ability to determine power limits more accurately through the use of network and differential analyzers. Two of the principal conclusions to which the present studies have led are that some benefit may be realized by using high rates of excitation response for sufficiently mild faults, or three-phase faults of very short durations, and that special intermediate low-transient reactance synchronous condensers, with properly co-ordinated regulators and excitation systems, can provide a practical method for increasing the stability limits of long single-circuit lines.

46-185-ACO—Columbia River Power; *E. I. Pease (M'29), H. W. Goodhue. 20 cents.* Prime power potentiality of the Columbia River system is about 50,000,000 kw, or twice the present average output of the nation. A third or more of this may be developed economically. Planning for comprehensive development of the river for power and all other beneficial purposes is a tremendous undertaking in which many agencies are participating. River regulation by storage and power co-ordination throughout the basin will be essential elements of that development. The power load has grown phenomenally in this region, nearly trebling in the last ten years, and early need for much greater hydroelectric installation is expected. Load characteristics will be important in the selection and design of projects. Large generating units generally will be advantageous.

46-191-ACO—Design Factors to Promote Reliability of Hydroelectric Station Auxiliaries; *C. L. Killgore (A'37). 15 cents.* Operation of a hydroelectric generating unit is dependent at all times upon the performance of its auxiliaries. The design of the electric distribution system and all other equipment associated with operation of hydroelectric station auxiliaries, as well as the auxiliaries themselves, must provide maximum reliability and continuity of service. Proper consideration of six important design factors, described in this paper, has insured dependable auxiliaries for over 2,500,000 kw of hydroelectric generating capacity in more than 30 power plants of the United States Bureau of Reclamation.

46-201-ACO—Hydroelectric Power System Design; *S. M. Denton (A'39). 25 cents.* This discussion is concerned with hydroelectric power plant design with particular attention given to the structures and the major machines and equipment. Its background is the design of power systems by the Bureau of Reclamation. The installed capacity of these systems approximates 2,500,000 kw. The hydroelectric power plants of the Bureau are located west of the 100th meridian in the arid and semiarid regions of the United States. Some of the problems peculiar to these multipurpose projects are outlined, especially the arrangement of the structures. Also some of the problems involved in the selection and designs for the major machines and equipment are discussed.

Power Transmission and Distribution

46-196—Characteristics of a 400-Mile 230-Kv Series-Capacitor-Compensated Transmission System; *B. V. Hoard (M'36). 30 cents.* Several new and interesting problems arise when series-capacitor compensation is used to increase the stability and amount of power to be transmitted over a long high-voltage transmission system. The major factors involved in a compensated system are discussed, using typical 400-mile two-circuit lines with two intermediate series capacitor stations. Line loadings are assumed which are considerably higher than could be carried with transient stability over a similar system without series compensation. The effects of short-circuiting the capacitor units during system faults, and of delay in reinserting the capacitors after the fault is cleared, are analyzed with respect to system stability and with respect to the amount of series compensation to be used. Transients in a series *L-R-C* circuit are analyzed briefly, because such transients introduce new relaying problems in the compensated system. Various relaying schemes for line protection and for protection of the series capacitor equipment during line faults are considered.

Protective Devices

46-177—4,370,000 Kva Short-Circuit Tests on Grand Coulee 230 Kv-Bus; *W. H. Clagett (M'46), W. M. Leeds (M'38). 20 cents.* The unusually large concentration of generating capacity at Grand Coulee Dam makes possible short-circuit power on the 230-kv bus considerably in excess of the rupturing capacity of circuit breakers now available at that voltage. Methods of sectionalizing the bus and segregating the transmission lines to limit the maximum short circuit to less than 3,500,000 kva are described in this paper. Three-phase faults up to 3,110,000 kva and single-phase-to-ground faults equivalent to 4,370,000 kv were cleared easily during a series of staged tests on a 230-kv 3-cycle 3,500,000-kva steel-tank oil circuit breaker. These tests confirm high power laboratory tests and suggest the practicability of constructing circuit breakers of still higher interrupting rating, the application of which would free the Coulee Dam system from present operating limitations.

46-199—Field Tests of Power Line Carrier Current Equipment; *R. H. Miller (A'36), E. S. Prud'homme (A'42). 15 cents.* This paper describes a series of field tests made on the power line carrier current telephone system of the Pacific Gas and Electric Company. Some of the test methods are outlined, and test results are given. A comparison of frequency and amplitude modulated systems is made, and data showing the relative response to noise of frequency modulated and amplitude modulated channels are presented. Considerable data and curves are given showing the audio and carrier frequency characteristics of various parts of the carrier telephone system. Some of the requirements for satisfactory performance and limitations of power line carrier equipment are discussed.

46-200—Sensitive Ground Relay Protection for Complex Distribution Circuits; *L. F. Hunt (F'38). 15 cents.* Protection engineers have been confronted with the problem of relaying ground faults on lower voltage circuits. This paper describes a method of isolating ground faults on complex feeders that has been in actual operation on the Southern California Edison Company's system for a period of six years. This method of relaying functions reliably on exceptional low values of ground current, with full ground faults limited to small values of current. This makes the operating range of ground relays up to ten times normal minimum trip current.

PERSONAL

C. J. Breitwieser (A '33, M '44) design engineer in charge of the radio electrical engineering department, Consolidated-Voltee Aircraft Corporation, San Diego, Calif., received the 1945 District 8 prize for initial paper for his paper, "Constant-Speed Drives for Aircraft Alternators." Born in Colorado Springs, Colo., in 1910, Mr. Breitwieser holds the degrees of bachelor of science from the University of North Dakota and master of science from California Institute of Technology. After two years as instructor at the University of North Dakota, Grand Forks, he was consulting engineer in Pasadena, Calif., from 1932 to 1935, and in the latter year he formed C. J. Breitwieser and Company, consulting engineering and manufacturing company. This company merged with another to form the Caldo Corporation in 1937. In 1939 he became consulting engineer for the De Forest Laboratories and in 1941 staff engineer for Consolidated-Vultee corporation.

E. W. Boehne (A '29, F '43) research engineer, general engineering division, General Electric Company, Philadelphia, Pa., received the 1945 best paper prize for District 2 as coauthor of the paper, "Anode-Circuit-Breaker Design and Performance Criteria." Born in 1905 in Laramie, Wyo., Mr. Boehne holds the degrees of bachelor of science and electrical engineer from the Agricultural and Mechanical College of Texas and the degree of master of science from Massachusetts Institute of Technology. He has been employed by the General Electric Company since 1926. at Lynn, Mass., and Schenectady, N. Y., as well as in Philadelphia, to which he was transferred in 1933. Mr. Boehne twice has received the Charles A. Coffin Award, In 1941 he was awarded the AIEE best paper prize for District 2 and in 1944 the national prize for the best paper in theory and research.

W. B. Buchanan (A '16, M '32) assistant laboratory engineer, Hydro-Electric Power Commission of Ontario, Toronto, Canada, has received the 1945 District 10 prize for best paper as coauthor of the paper, "Field Tests of Interrupting Capacity of 138-Kv Oil Circuit Breakers." Mr. Buchanan was born in Grey County, Ontario in 1885, and holds the degrees of bachelor of science and electrical engineer from the University of Toronto. He was a demonstrator at the University of Toronto from 1913 to 1916 and in 1916 assumed charge of general electrical testing in the laboratories of the Hydro-Electric Commission.

G. D. Floyd (A '19, M '28) electrical consultant, electrical engineering department, Hydro-Electric Power Commission of Ontario, Toronto, Canada, has received the 1945 District 10 prize for best paper as coauthor of the paper, "Field Tests of Interrupting Capacity of 138-Kv Oil Circuit Breakers." Mr. Floyd was born in Nova Scotia in 1892 and received the degree of bachelor of science from Dalhousie University and from McGill University. He also studied in the graduate school of Cornell University. He worked for a time in 1915 for the Westinghouse Electric and Manufacturing Company in East Pittsburgh, Pa. In 1919, after serving in the Royal Flying Corps in World War I, he joined the Hydro-Electric Commission. He was assigned to the Commission's laboratories until 1926 when he was transferred to the electrical engineering department.

E. C. Goodale (A '27, M '45) electrical engineer, Control Section, Bonneville Power Administration, Portland, Oreg., received the 1945 District 9 prize for best paper as coauthor of the paper, "Field Determination of Current Transformer Errors by the Secondary-Voltage Method." Mr. Goodale was born in Riverhead, N. Y., in 1898, and received the degree of mechanical engineer from Cornell University. After graduation he was cadet engineer with the Syracuse (N. Y.) Lighting Company and in 1925 went to Long Beach, Calif., for Stone and Webster Construction Company. He was relay and meter inspector with the Puget Sound Power and Light Company, at Tacoma and Olympia, Wash., from 1926 to 1940 and in 1940 became electrical engineer with the Bonneville Administration.

J. V. Kresser (A '32, M '43) district engineer, Westinghouse Electric Corporation, San Francisco, Calif., has received the 1945 District 8 prize for best paper for his paper, "Characteristics and Limitations of Transformer Connections." Mr. Kresser was born in 1904 in Noumea, New Caledonia. After his graduation from Massachusetts Institute of Technology, he was employed from 1930 to 1932 by the Westinghouse corporation at East Pittsburgh, Pa. From 1933 to 1937 he was associated variously with the Spreckels Sugar Company, Spreckels, Calif.; the Electrolift Corporation; and the Standard Oil Company of California, San Francisco. He became district engineer for the Westinghouse Electric Corporation in 1937.

J. L. Holbeck (A '24, M '36) chief of the meter unit of the operation and maintenance department, Bonneville Power Administration, Portland, Oreg., received the 1945 District 9 prize for best paper as coauthor of the paper, "Field Determination of Current Transformer Errors by the Secondary-Voltage Method." Born in Soudan, Minn., in 1897, Mr. Holbeck was graduated from the University of Minnesota in 1924. He was employed by the Minnesota Power and Light Company, Duluth, from 1924 until in 1938 he joined the Bonneville project as associate engineer.

W. B. Keller (A '41) electrical test and design engineer, Leece-Neville Company, Cleveland, Ohio, has received the District 2 prize for initial paper for 1945 for his paper, "Aircraft Regulators and Relays." Mr. Keller, who was born in Cleveland in 1917, was graduated from the Case School of Applied Science in 1940. He previously was employed by the Cleveland Electric Illuminating Company and is a member of the Society of Automotive Engineers.

F. W. Grover (A '21, M '30) professor of electrical engineering, Union College, Schenectady, N. Y., has retired. Doctor Grover, who was born in Lynn, Mass., in 1876, holds the degrees of bachelor of science from Massachusetts Institute of Technology, master of science from Wesleyan University, doctor of philosophy from George Washington University, and doctor of philosophy from Ludwig-Maximillan University (Munich). Doctor Grover commenced his teaching career as instructor in physics and astronomy at Wesleyan University and instructor in electrical engineering at Lafayette College. From 1902 to 1911 he was associated with the United States Bureau of Standards as physicist. He was professor of electrical engineering at Colby College, Waterville, Me., from 1911 to 1920. He joined the faculty of Union College in 1922 as assistant professor, becoming associate professor later that year and professor in 1932. He was a consultant to the Bureau of Standards until 1938 and is the author of several books and many technical papers. He is a member of the Institute of Radio Engineers, the American Association for the Advancement of Science, the American Physical Society, and the American Association of University Professors. He also is a member of Eta Kappa Nu.

W. G. Hoehn (A '35) formerly electrical engineer in the engineering department, American Transformer Company, Newark, N. J., has been made manager of power, distribution, and air-filled transformers. **T. W. Stauber** (A '43) formerly electrical engineer with the company, has been made manager of specialty air-insulated transformers and transtats.

M. L. Waring (A '29, M '36) formerly division engineer in system engineering, Consolidated Edison Company of New York (N. Y.), Inc., has been transferred to the service bureau. **T. C. Duncan** (A '30) formerly in purchasing and stores succeeds Mr. Waring. The transfers have been made as part of the company's executive development plan.

T. S. Sloan (A '21, M '32) vice-president, Georgia Power Company, Columbus, Ga., has been given an indefinite leave of absence because of illness and has resigned his position. Mr. Sloan has been with the company and its predecessors since 1908 and has been in Columbus since 1937.

Marie Lovett Foote (Student Member) June 1946 graduate of Duke University, has joined the AIEE editorial staff in New York, N. Y., as editorial assistant. Miss Foote was born November 29, 1926, in Brewton, Ala. She was graduated first in her class from the Murphy High School, Mobile, Ala., and received the degree of bachelor of science in electrical engineering from Duke University. For a time she was assistant in instruction in the university's civil engineering laboratory. She served as treasurer of the AIEE Student Branch at Duke University and was a member of the circulation staff of the *Duke Engineer*. She is a member of Phi Beta Kappa and was active in many college societies.

M. L. Foote

J. J. Ryan (M '23) president of the Edison Savings and Loan Association of the Consolidated Edison Company of New York, (N. Y.) Inc., has retired. Born in New York in 1881, Mr. Ryan was graduated from Columbia University in 1909 with the degree of electrical engineer. However his association with the Edison System had commenced in 1896 when he was employed in the now outmoded position of lamp boy which involved his changing the lamps on the premises of the company's customers. After graduation he was given charge of the extension and estimating department in the Bronx district of the New York Edison Company. Thereafter he was made assistant general foreman in the Bronx district in 1910, assisting operating superintendent in 1912, assistant superintendent in 1915, head draftsman in 1920, and superintendent in 1922. He was elected a director of the Savings and Loan association in 1927, vice-president in 1937, and president in 1943. He is a member of Tau Beta Pi and Sigma Xi.

Fred Clarke (A '21, M '30) merchandise manager, Western Electric Company, New York, N. Y., has retired. Mr. Clarke was graduated from Armour Institute in 1907 with the degree of bachelor of science and in 1912 received the degree of electrical engineer. Mr. Clarke's association with the Bell System commenced in 1905, at which time he was assistant traffic manager of the Chicago (Ill.) Telephone Company. After a period with the Michigan State Telephone Company, he joined the American Telephone and Telegraph Company in 1918. In 1921 he was transferred to the Ohio Bell Telephone Company as building and equipment engineer. Shortly afterwards, in 1923, he became general installation engineer for the Western Electric Company. He was appointed general sales engineer in 1927 and general merchandise manager in 1939. During World War II he served on an advisory committee of the War Production Board and in 1944 was appointed a member of its communications division committee on disposal of surplus equipment. He has served as councilman and on the town board of adjustment in Leonia, N. J.

L. B. Bender (A '20, M '27) formerly supervisor of engineering production, radio division, Westinghouse Electric Corporation, Baltimore, Md., has retired. Colonel Bender was graduated from Kansas State College in 1904 and received the degree of bachelor of science in electrical engineering from Massachusetts Institute of Technology in 1920. He was an officer in the United States Army from 1909 until 1940 when he retired as a colonel. He was in the Coast Artillery Corps until 1917 and after that in the Signal Corps. For more than 12 years he had executive control of the research and development work of the Signal Corps as a member of the staff of the Chief Signal Officer, Washington, D. C., as director of the Signal Corps Laboratories, Fort Monmouth, N. J., and as director of the Aircraft Radio Laboratory, Wright Field, Ohio. In World War I he received the Distinguished Service Medal and during World War II was recalled to active duty as Signal Officer, Second Service Command, Governors Island, N. Y. He joined the Westinghouse corporation in 1940.

E. A. LeFever (M '34) general superintendent of meters, Buffalo (N. Y.), Niagara and Eastern Power Corporation, has retired. After his graduation from Purdue University in 1901, Mr. LeFever spent two years in the test department of the General Electric Company, Lynn, Mass. He joined the Buffalo Niagara system in 1903 as foreman of the meter department. Until 1930 he had charge of the electrical measurement work of the company. He then was given supervision of policies and methods of installing measuring devices. In 1931 he was elected chairman of the operating committee of the Niagara Hudson system. Mr. LeFever for many years was extremely active in the committee work of the National Electric Light Association and was an officer of the meter committee of the Edison Electric Institute.

F. J. Stevens (A '12, F '44) formerly vice-president in charge of engineering, American Lava Corporation, Chattanooga, Tenn., has been elected vice-president and director of D. M. Steward Manufacturing Company, Chattanooga. Mr. Stevens holds the degree of electrical engineer (1913) from Rensselaer Polytechnic Institute. After his graduation he was employed as junior railway engineer with the Public Service Commission, First District, New York, until in 1916 he joined the Locke Insulator Manufacturing Company, Baltimore, Md. In 1928 he was appointed assistant general manager of Isolantite Company of America, Inc., Belleville, N. J. He had been associated with the American Lava Corporation in various capacities since 1931 and had been vice-president since 1934. During the World War II he was loaned to the British Air Ministry as a consultant on steatite insulator production.

P. M. Gunzbourg (M '41) president, MacDonald International, Inc., New York, N. Y., and consulting engineer, has been awarded by the War Department, a Certificate of Appreciation for "patriotic services in a position of trust and responsibility" as consultant during the war to the Director of Intelligence of the Army Service Forces. At the outbreak of war in Europe, Mr. Gunzbourg served the British Government in His Majesty's Office of Works in France. Mr. Gunzbourg was born in Russia, served under the Czar's government, and worked in the electrical trust under the Soviet Government. Before the 1917 Revolution he was associated with the Russian Siemens Company and after 1926 with the Belgian and French companies. He has been in the United States since 1940.

O. J. M. Smith (A '42) formerly chief electrical engineer, Scranton (Pa.) Record Company, is now chief electrical engineer of the Summit Corporation, Scranton. Doctor Smith holds the degrees of bachelor of science in chemistry from Oklahoma Agricultural and Mechanical College (1938), bachelor of science in electrical engineering from the University of Oklahoma (1938), and doctor of philosophy from Stanford University (1941). He has been an instructor at Tufts College, Medford, Mass., assistant professor at the University of Denver, Colo., and research engineer for the Westinghouse Electric Corporation, East Pittsburgh, Pa.

F. S. Black (A '34, M '44) formerly assistant planning engineer, Potomac Electric Power Company, Washington, D. C., has been appointed assistant to the president of the company. Mr. Black received the bachelor of science degree in electrical engineering from the University of North Carolina and the bachelor of law and master of laws degrees from the National Law School. Mr. Black has been with the company since 1934. He has been instructor in evening classes at the University of Virginia. He is chairman of the AIEE Washington Section, editor of the *Monthly Calendar* of the District of Columbia Council of Engineering and Architectural Societies, and a member of the Washington Board of Trade, the Washington Society of Engineers, and the District of Columbia's Commissioner's Committee on Veterans Housing.

M. C. Heffelman (M '45) formerly vice-president and general manager, New Mexico Power Company, Santa Fe, has been elected president of the company. He also will continue as general manager. Mr. Heffelman, who received the bachelor of science degree in 1924 and the electrical engineering degree in 1933 from the University of Arizona, early in his career was with the Phelps Dodge Corporation and with the Chile Exploration Company as supervisor of electric equipment at Chuquicamata, Chile, from 1925 to 1931. His first utility association was with the Tucson Gas Electric Light and Power Company in 1931 and 1932. He was made general manager of the Deming Ice and Electric Company in 1933, was appointed vice-president and manager in 1940, and later that year president and manager. He was elected vice-president and general manager of the New Mexico company in 1942.

S. B. Williams (A '07, F '26) switching development engineer, Bell Telephone Laboratories, Inc., New York, N. Y., has retired from that position, but plans to open a consulting engineering office in Brooklyn, N. Y. Mr. Williams has been associated with the Bell System since he joined the Western Electric Company in Chicago, Ill., in 1905 after his graduation from Ohio State University. He was transferred to the company's circuit laboratory in New York in 1908 and to Bell Laboratories when they were organized in 1925. Since 1938 he has been concerned especially with calculating and computing device and systems, notably the development of the all-purpose computer for the Armed Forces which was constructed under his direction. He is a member of Sigma Xi and Tau Beta Pi.

P. H. McAuley (A '36, M '43) formerly staff engineer, Westinghouse Electric Corporation, East Pittsburgh, Pa., has been appointed vice-president of the Construction Acceptance Corporation, Pittsburgh, Pa. Mr. McAuley was graduated from Queens University in 1923 and joined the Westinghouse corporation the same year. He was in the transmission engineering department from 1924 to 1927 and after that in the engineering laboratories. In 1940 he was appointed to a liason group working on special problems.

Sidney Withington (M '20, F '24) formerly electrical engineer, New York, New Haven and Hartford Railroad Company, New Haven, Conn., has been appointed chief electrical engineer. Mr. Withington was graduated from Harvard College in 1906 and from the Harvard Engineering School in 1907. After a year as a teaching fellow at Harvard College, Cambridge, Mass., he was employed from 1908 to 1910 by the Walworth Manufacturing Company, Boston, Mass. Since 1910 he has been associated with the New York, New Haven and Hartford Railroad. Mr. Withington has written a number of technical papers and is a member of the American Society of Mechanical Engineers, the Newcomen Society, and the Railway-Locomotive Historical Society. He has served on committees of the American Standards Association.

E. C. Crittenden (A '19, F '44) assistant director, National Bureau of Standards, Washington, D. C., has been awarded the Illuminating Engineering Society Medal. The medal is given in recognition of meritorious achievement which has conspicuously furthered the profession, art, or knowledge of illuminating engineering. Mr. Crittenden has made notable contributions to the development and establishment of acceptable standards and units for the measurement of light. He is a past president of the IES, the United States National Committee of the International Commission on Illumination, the Optical Society of America, the United States National Committee of the International Electrotechnical Commission, the Washington Academy of Sciences, and the Philosophical Society of Washington.

A. L. Whitman (A' 22, M '30) lieutenant colonel, United States Signal Corps, has returned to Bell Telephone Laboratories, Inc., New York, N. Y. During his term of service in the Armed Forces, Mr. Whitman was executive officer of the Camp Evans Radar Development Laboratory and officer in charge of the Equipment Coordination Branch, the Camp Evans Signal Laboratory. In 1943 he went overseas and served on the staff of the Service of Supply Headquarters in Brisbane, Australia; as base signal officer on New Guinea; as signal officer on Luzon; and with an advance reconnaissance detachment in Manila. He later was communications officer in Manila and signal officer in Batangas.

W. A. Coates (A '14, F '26) formerly sales manager, switchgear department, Metropolitan-Vickers Electrical Company, Ltd. Manchester, England, has been appointed manager of home sales for the company. Mr. Coates attended Finsbury College and has been associated with Siemens Brothers and the British Westinghouse Company. He was chief engineer of the Canadian Electrical Company from 1912 to 1917. He has been in the employ of the Metropolitan-Vickers Company since 1919, except for the years of 1922 and 1923 which he spent in Japan and Australia for the Metropolitan-Vickers Export Company. He was appointed sales manager of the switchgear department in 1936.

S. T. Arnold (M '44) formerly distribution engineer, Boston (Mass.) Edison Company, is now with the electrical engineering department of the Army Service Forces, Manhattan District, Corps of Engineers, Oak Ridge, Tenn. Mr. Arnold was graduated from Randolph Macon College in 1926 and also holds the degrees of bachelor and master of science from Massachusetts Institute of Technology. He had been associated with the Edison company since 1931. At Oak Ridge he is concerned at present with process production and improvement at the electromagnetic isotope separation plant.

C. P. Cooper (A '08, M '21) formerly vice-president and director, American Telephone and Telegraph Company, New York, N. Y., recently became executive vice-president of the company. Mr. Cooper was graduated from Ohio State University in 1907 and the following year entered the Bell System as junior engineer for the New York Telephone Company. In 1918 he was sent to Washington, D. C., to assist in the expansion of the facilities of the Chesapeake and Potomac Telephone Company as general plant superintendent. He was appointed general manager of the Cleveland (Ohio) Telephone Company in 1920, and, when this became part of the Ohio Telephone Company, he was appointed vice-president and general manager of the new company. He has been vice-president of the American Telephone company since 1926. Mr. Cooper is president of the Presbyterian Hospital, New York; the United Hospital Fund of New York; and a director of the Guaranty Trust Company of New York.

M. M. Brandon (A '34, F '44) formerly associate electrical engineer for the Underwriters' Laboratories, has been appointed electrical engineer and as such will have full responsibility and direction of the activities of the electrical department of the laboratories in Chicago, Ill.; New York, N. Y.; and San Francisco, Calif. His headquarters will be in New York. Mr. Brandon holds the degrees of bachelor of science (1919) and electrical engineer (1936) from Mississippi State College. He joined the Underwriters' Laboratories in 1921 in Chicago. He has been active in the affairs of the International Association of Electrical Inspectors and of the electrical committee of the National Fire Protection Association.

A. J. Devereaux (A '37) formerly electrical engineer, J. F. Pritchard and Company, Kansas City, Mo., has been appointed electrical engineer in charge of the electrical engineering department of the Otter Tail Power Company, Fergus Falls, Minn. Mr. Devereaux was graduated from Iowa State College in 1922. He was associated with the General Electric Company, Schenectady, N. Y., in the testing, construction, and switchgear departments from 1922 to 1935. In 1935 he became assistant electrical engineer for the Central Nebraska Public Power and Irrigation District and later was electrical engineer in charge of design for the Continental Oil Company, Ponca City, Okla. He joined the J. F. Pritchard company in 1942.

J. G. Tarboux (A '21, F '43) formerly head of the department of electrical engineering, University of Tennessee, Knoxville, has been appointed professor of electrical engineering at Cornell University, Ithaca, N. Y. Professor Tarboux was graduated from Clemson Agricultural College in 1918 and from Cornell University received the degrees of electrical engineer in 1923, master of electrical engineering in 1926, and doctor of philosophy in 1937. He was made instructor in electrical engineering at Cornell University in 1920 and assistant professor in 1926. He joined the University of Tennessee faculty in 1929. He is the author of several books and a member of Eta Kappa Nu, Tau Beta Pi, and Sigma Xi.

David Sarnoff (M '23) president of the Radio Corporation of America, New York, N. Y., recently awarded the Medal for Merit, was commended because he "placed the full resources of his company at the disposal of the Army whenever needed, regardless of the additional burden imposed upon his organization. He encouraged key personnel to enter the service, and at his direction, RCA engineers and technicians rendered special assistance on numerous complex communications problems. He fostered electronic advances which were adapted to military needs with highly beneficial results." Mr. Sarnoff previously was awarded the Legion of Merit medal in 1944 for his services overseas as brigadier general.

T. M. Odarenko (M '42) products line manager, Federal Telephone and Radio Corporation, Clifton, N. J., who during the war was technical director of the radio frequency transmission lines and fitting section of the electronics division of the Bureau of Ships, has been presented with the Distinguished Civilian Service Award for "outstanding service to the United States Navy in the field of electronics during World War II." Among the contributions mentioned in the citation were "the development and production of the new cable dielectric Polyethylene. . . a unified joint Army–Navy inspection procedure. . . standardization of the Army–Navy use of approximately 40 cable types in contrast to the 200 odd types which were in current use. . . formation of the War Committee on Dielectrics."

C. O. Bickelhaupt (M '22, F '42) vice-president and secretary, American Telephone and Telegraph Company, New York, N. Y., and brigadier general in the United States Signal Corps during World War II recently received the Distinguished Service Medal in recognition of his service as director of the communications division and director general of the Signal Communications Service in the European theater of operations from December 1944 to July 1945. Mr. Bickelhaupt, who had been in military service in World War I, was recalled to active duty in 1941. He was assigned to the Office of the Chief Signal Officer in Washington, D. C., and was liaison officer, assistant director of planning, chief of the executive control branch, director of the control division, and assistant executive. Before going overseas in 1944 he was commanding officer of the replacement training center at Fort Monmouth, N. J.

D. D. Smalley (A '20, M '33) formerly superintendent, central area, operation department, Pacific Gas and Electric Company, San Francisco, Calif., has been named engineer of electric operation. Shortly after his graduation from the University of California in 1910, Mr. Smalley joined the Merced River Company which later merged with the San Joaquin Light and Power Corporation. In 1934 he became general superintendent of the San Joaquin and Midland County systems and in 1944 was appointed superintendent of the central area, **G. H. Hagar** (A '20, M '26) formerly assistant engineer in the operations department succeeds Mr. Smalley as superintendent of the central area. Also a graduate of the University of California, Mr. Hagar has been with the company since 1913.

Harris Reinhardt (M '42) formerly quality supervisor, appliance department, Sylvania Electric Products, Inc., Ipswich, Mass., has been appointed manager of the commercial engineering department of the company's lighting division. Mr. Reinhardt, who holds the degrees of bachelor of science from the University of Arkansas and master of science from Ohio State University, has been with the company since 1940. Previously he was associated with the Westinghouse Lamp Division, Bloomfield, N. J.

G. A. Waters (A '07, F '21) formerly chief engineer, electric division, engineering department, Wagner Electric Corporation, St. Louis, Mo., has been appointed vice-president in charge of manufacturing. In 1907, after his graduation from Syracuse University, Mr. Waters became an instructor at Washington University, St. Louis. He joined the Wagner Corporation in 1909 as student engineer. Mr. Waters recently received a citation from the United States Army for his liaison work with the Ordnance Division during the war. He is a past president of the St. Louis Electrical Board of Trade and the St. Louis Engineers' Club and a member of the Society of Automotive Engineers.

A. M. MacCutcheon (A '12, F '26) senior vice-president, Reliance Electric and Engineering Company, Cleveland, Ohio, and AIEE past president (1936–37), has retired. However, he will remain available to the company as a consultant. Mr. MacCutcheon, a graduate of Columbia University, joined the Reliance company in 1914 to design a new line of adjustable speed d-c motors. He became chief engineer in 1917, and engineering vice-president in 1923 and has continued as an officer of the company since that time. Mr. MacCutcheon has been active in the development of the Cleveland Technical Societies Council and has been chairman of the city's Water Action Committee.

F. R. George (A '13, M '25) engineer of electric operation, Pacific Gas and Electric Company, San Francisco, Calif., has retired. Mr. George was graduated from the University of Southern California in 1901 and shortly afterwards was associated with the Mutual Electric Light Company, San Francisco and the Bay Counties Power Company, Oakland, Calif., both predecessors of the Pacific Gas and Electric Company. When the latter company was incorporated in 1905 he remained as engineer at Oakland. He became chief load dispatcher in 1910 and was transferred to San Francisco in 1908. In 1921 he was made engineer of electric operation. He is a member of the Pacific Coast Electric Association.

F. V. Smith (A '23, M '38) a partner and assistant chief electrical engineer, Sargent and Lundy, Engineers, Chicago, Ill., has been appointed chief electrical engineer of the firm. Mr. Smith was born in 1900 in Victoria, Australia, and holds the degrees of bachelor and master of science from the University of Melbourne. He was with the Westinghouse Electric and Manufacturing Company from 1922 to 1927. In 1927 he joined the staff of Sargent and Lundy and in 1945 became a partner and assistant chief electrical engineer. Mr. Smith has been chairman of the AIEE Chicago Section and has served on a number of AIEE committees.

F. H. Hollister (A '08, F '43) partner and chief electrical engineer, Sargent and Lundy, Engineers, Chicago, Ill., has retired. After his graduation from the University of Michigan in 1906, Mr. Hollister was associated with the General Electric Company in Schenectady, N. Y., and Atlanta, Ga., until 1916. In that year he joined the staff of Sargent and Lundy and in 1930 became chief electrical engineer. He has served on a number of AIEE committees and was chairman of the power generation committee in 1935–36. He is a member of the Western Society of Engineers.

John Van Veen (A '20, M '28) formerly superintendent, electric operating department, Cincinnati (Ohio) Gas and Electric Company, has been appointed assistant manager of the electric department. Mr. Van Veen joined the company in 1913 soon after coming to the United States from Holland. **S. M. Hamill, Jr.** (A '28, M '36) formerly assistant superintendent, electric operating department, succeeds Mr. Van Veen as superintendent. He has been with the company since 1923.

Sydney Alling (A '12) formerly engineer in the industrial department, Rochester (N. Y.) Gas and Electric Corporation, has been named manager of the department. Mr. Alling was graduated from the University of Rochester and received the degree of electrical engineer from the Massachusetts Institute of Technology. He entered the employ of the Rochester company in 1911 and has been in the industrial department since 1931.

H. E. Edwards (A '41) formerly design engineer, Westinghouse Electric Corporation, Mansfield, Ohio, has been made section engineer in charge of laundry equipment engineering. Mr. Edwards, who joined the corporation in 1932, previously was associated with the Columbia Steel Company, Elyria, Ohio, and the National Tube Company, Lorain, Ohio.

C. D. Kester (A '13) formerly manager, machinery electrification section, industrial department, Westinghouse Electric Corporation, Philadelphia, Pa., has been appointed manager of the York, Pa., office of the corporation. A graduate of Lehigh University, Mr. Kester joined the Westinghouse corporation in 1912 and has been manager of the materials handling machinery section and of the synchronous motor section.

J. A. Wood, Jr. (A '30) formerly assistant professor of electrical engineering, Massachusetts Institute of Technology, Cambridge, has been appointed to the faculty of the Thayer School, Dartmouth College, Hanover, N. H., as assistant professor of electrical engineering. He will supervise the installation of new electrical laboratory equipment and will direct the electronics work in the school's new electrical engineering course.

U. R. Furst (A '44) formerly chief electronic engineer, engineering department, Russell Electric Company, Chicago, Ill., recently formed his own company, Furst Electronics, Chicago. Mr. Furst received the degrees of master of science in 1935 and doctor of philosophy in 1938 from the University of Vienna. He is a member of the Institute of Radio Engineers.

E. W. Grover (M '29) superintendent of substations, Commonwealth Edison Company, Chicago, Ill., has retired. Mr. Grover was graduated from Armour Institute of Technology in 1904. He was employed first by the company on a construction project in 1904, later that year entering the substation department as operator, in 1906 becoming district operator. He was appointed assistant superintendent of substations in 1910 and superintendent of substations in 1935.

F. J. Gallogly (A '41) formerly assistant electrical engineer, field production department, United States Navy Yard, Brooklyn, N. Y., has joined the staff of the American Standards Association, New York, N. Y. Mr. Gallogly was graduated from Manhattan College in 1940 and before joining the Navy Department in 1941 was employed by the Ingersoll-Rand Company.

W. B. Creagmile (A '07) formerly technical engineer, J. G. Biddle Company, Philadelphia, Pa., has retired. Mr. Creagmile was graduated from Drexel Institute in 1896. After 20 years on the faculty of Drexel Institute, he joined the Biddle Company in 1919. He has been technical engineer and engineering adviser to Mr. Biddle and to the sales and manufacturing staffs of the company, and is the author of many of the company's publications.

A. A. Browne (A '38) formerly manager, sales and engineering, Joshua Hendy Iron Works, Sunnyvale, Calif., has been appointed general manager of the Pacific Electric Manufacturing Corporation, San Francisco, Calif. Mr. Browne, a 1930 graduate of the University of Washington, was associated with the Westinghouse Electric Corporation, San Francisco, from 1930 to 1941. In 1942 he became assistant to the president of the Joshua Hendy works.

F. B. Jewett (A '03, HM '45) retired vice-president of the American Telephone and Telegraph Company, New York, N. Y., has received the Medal of Merit for "outstanding services as president of the National Academy of Sciences and as member of the National Defense Research Committee.

D. F. Tuttle, Jr. (A '38) who recently returned to Bell Telephone Laboratories, Inc., after serving as a naval lieutenant in the Pacific, has received a Gerard Swope Fellowship. The fellowships are awarded annually by the General Electric Company to electrical engineering graduates who have demonstrated outstanding abilities in the field of engineering and research. Mr. Tuttle is studying for his doctorate at Massachusetts Institute of Technology.

R. E. Roesch (A '25, M '33) formerly colonel in the United States Signal Corps, is now with the International General Electric Company, Schenectady, N. Y. Mr. Roesch served with the Signal Corps from 1941 to 1946 with the major portion of his service in the Far East. Before the war he was with Stone and Webster Engineering Corporation.

B. L. Kilgour (M '38) formerly vice-president, Cincinnati (Ohio) and Suburban Bell Telephone Company, has been elected president of the company. Mr. Kilgour was graduated from Harvard University in 1927 and commenced work with the American Telephone and Telegraph Company, New York, N. Y. He was transferred to the Cincinnati company in 1930, becoming assistant to the president and then vice-president. He is a member of the Newcomen Society and the Caledonian Society and a director of the Central Trust Company and the Street Railway Company, both of Cincinnati.

P. L. Adkins (A '37) formerly engineer with the United States Engineers, Portland, Oreg., has been sent to Formosa and Northern China with a party of engineers which is making a rehabilitation survey of transmission and distribution facilities for the J. G. White Engineering Corporation, New York, N. Y. A graduate of Oregon State College, Mr. Adkins has had 20 years experience with power companies on the Pacific Coast, and worked on Rural Electrification Administration projects in Washington, Idaho, and Oregon. He joined the United States Engineers in 1942.

Clinton Rector (A '27) formerly general sales manager, Catalin Corporation, New York, N. Y., has been appointed vice-president of National Engineering Products, Inc., Washington, D. C. Mr. Rector was graduated from Johns Hopkins University in 1924, and for four years thereafter was employed by the Westinghouse Electric Corporation, Pittsburgh, Pa. From 1928 to 1944 he was sales engineer for the Bakelite Corporation, New York, N. Y. In 1944 he was made sales manager for the Catalin Corporation. He is member of Tau Beta Pi.

J. N. Mochon (A '45) chief examiner, Quebec Board of Electrical Examiners, Montreal, Canada, has retired from that position. He was named to the board which he organized first in 1919, at which time he was acting as assistant superintendent of lighting for the City of Montreal. Before 1914 he was connected with the sales organization of Allis-Chalmers-Bullock, Ltd., Montreal, and was a partner in the Quebec agents of the Swedish General Electric Company.

D. L. Solomon (A '40, M '43) formerly project engineer, telephone engineering department, Federal Telephone and Radio Corporation, Newark, N. J., has been appointed assistant chief telephone engineer, Stromberg-Carlson Company, Rochester, N. Y. Mr. Solomon, a 1936 graduate of Purdue University, has been transmission engineer with the Western Union Telegraph Company, Chicago, Ill., and consulting telephone engineer with the estate of H. M. Friendly, Chicago. He is a member of the communications section of the Association of American Railroads.

J. E. Hunt (A '43) formerly superintendent of generating stations, Philadelphia (Pa.) Electric Company, has been appointed administrative engineer of electric operations. Associated with the company since 1904, Mr. Hunt has been superintendent of its Schuykill Station from 1917 to 1925 and superintendent of its Richmond Station from 1925 to 1939. In the latter year he became superintendent of generating stations.

M. M. Kenneally (M '29) of the sales and engineering department, Joslyn Manufacturing and Supply Company, Chicago, Ill., has been made sales manager for the company. A graduate of Iowa State College, Mr. Kenneally formerly was associated with the United Gas Improvement Company, Philadelphia, Pa.; the Ohio Brass Company, New York, N. Y.; and the Porcelain Insulator Corporation, Lima, N. Y. He entered the employ of the Joslyn company in 1944.

R. T. Strong (A '39) formerly captain, United States Navy, has rejoined the Westinghouse Electric Corporation as manager of its San Diego, Calif., office. Called to active duty in 1941, Captain Strong served as supervising beachmaster in the assaults on Attu, Kiska, Kwajalein, Guam, and Leyte. He received the Legion of Merit Medal and the Bronze Star.

H. N. Misenheimer (M '37) formerly lieutenant colonel, United States Army, has returned to Bell Telephone Laboratories, Inc., New York, N. Y. Colonel Misenheimer served with the Signal Corps at Mitchel Field, N. Y., Fort Monmouth, N. J., with the Office of Strategic Services in Washington, D. C., and in Australia and New Guinea. For meritorious service as signal officer for all of New Guinea he was awarded the Bronze Star Medal.

W. G. Hall (A '38 M '45) formerly manager of the renewal parts department, Reliance Electric and Engineering Company, Cleveland, Ohio, has been made manager of a combined renewal parts and service division for the company. Mr. Hall, a 1934 graduate of the Case School of Applied Science, also received the degree of electrical engineer from that institution in 1943. He has been with the Reliance company since 1937.

R. E. Armington (A '42) formerly with the electrical engineering design department, Westinghouse Electric Corporation, Sharon, Pa., has joined the staff of the Ordnance Research Laboratory of Pennsylvania State College, State College, as assistant professor of engineering research. Professor Armington received his bachelor of science degree from Tufts College in 1940 and his master of science degree from New York University in 1941, and in the latter year entered the employ of the Westinghouse corporation.

G. A. Sawin (A '03, M '13) director of the regulatory legislation department, National Electrical Manufacturers Association, New York, N. Y., has retired. Mr. Sawin was associated early in his career with the General Electric Company, Lynn, Mass., and with the Public Service Electric and Gas Company, Newark, N. J. From 1920 to 1939 he was with the Westinghouse Electric Corporation, East Pittsburgh, Pa. He joined the National Electrical Manufacturers Association in 1939.

F. M. Farmer (A '07, F '13) vice-president and consulting engineer, Electrical Testing Laboratories, Inc., New York, N. Y., and past president of AIEE, recently was awarded a certificate of "Commendation for Meritorious Civilian Service" by the War Department for "outstanding performance of duty" as technical consultant, New York Ordnance District, from March 1942 to April 1945.

W. C. Cauthen (M '36) formerly colonel, Ordnance Department, Army of the United States, has joined C. F. Braum and Company, Alhambra, Calif. Mr. Cauthen, who entered the service as captain in 1940, served in Australia, New Guinea, and the Philippines and holds the Legion of Merit award and the Bronze Star Medal. He is a 1924 graduate of the University of California.

E. L. Moreland (A '11, F '21) has relinquished his position as dean of the school of engineering, Massachusetts Institute of Technology, Cambridge, Mass., to resume active partnership in the firm of Jackson and Moreland, Boston, Mass., from which he has been on leave of absence during the war years. Mr. Moreland will continue at the institute on a part-time basis as executive vice-president.

J. B. Trevor (A '34) who served as civilian engineer on the staff of the Naval Research Laboratory, Anacostia, D. C., during the war, has been presented with the Navy's Meritorious Civilian Service Award "for devising methods required to analyze X-ray radiations from radar equipment, so that means could be provided for preventing injury to operating personnel."

C. G. Suits (M '41) vice-president and director of the research laboratory, and **H. A. Winne** (A '16, F '45) vice-president in charge of engineering policy, General Electric Company, Schenectady, N. Y., and **Zay Jeffries** (M '36, F '42) vice-president and general manager of the company's chemical department at Pittsfield, Mass., have been appointed as an advisory committee on the research program in atomic energy which the company will undertake at Hanford, Wash.

C. J. Hejda (M '36, F '44) formerly chief testing engineer, Commonwealth Edison Company, Chicago, Ill., has retired. Mr. Hejda commenced his career with the company in 1903 as a draftsman. He then became an apprentice substation operator and in 1924 was appointed senior testing engineer. He was advanced to chief testing engineer in 1936.

H. V. Rathbun (A '29, M '37) formerly lieutenant colonel in the United States Signal Corps, has returned to his position with the Copperweld Steel Company and will reside in Kansas City, Mo. Mr. Rathbun first joined the company in 1941. In the Army he was commander of a signal battalion which installed communication equipment for the Army Air Forces in India.

W. R. Graham (A '38) formerly lieutenant, United States Naval Reserve, has resumed his duties as New York district manager for the Ohio Brass Company. Mr. Graham previously held this position from 1938 until he was called to active duty in 1943.

H. F. Brown (A '23, M '25) formerly assistant electrical engineer, New York, New Haven and Hartford Railroad Company, New Haven, Conn., has been appointed engineer of electric traction. Mr. Brown was graduated from Yale University in 1907 and has been with the railroad since 1910.

W. L. Whyte (A '35) formerly electrical engineer, Public Works Department, the Uganda Protectorate Government, Kampala, has received a promotion in the Colonial Civil Service and is now engineer of the Electrical Department in Malaya.

O. W. Eshbach (A '17, F '37) dean, Northwestern Technological Institute, Evanston, Ill., has been awarded the Octaue Chanute Medal for 1945 by the Western Society of Engineers. The medal, founded in 1901, is awarded annually for the best paper on some aspect of engineering education.

N. J. Roberts (A '44) formerly division industrial engineer, Ohio Public Service Company, Cleveland, has been appointed chief industrial engineer for the company. Mr. Roberts joined the company in 1923 as industrial engineer a year after his graduation from Purdue University.

Charles Friedman (A '45) formerly lieutenant, junior grade, United States Navy, has been appointed assistant sales manager of the Radio Receptor Company, New York, N. Y. A graduate of Massachusetts Institute of Technology, Mr. Friedman was a civilian engineer with the United States Army Signal Corps before he joined the Navy.

A. F. Morairty (A '43) formerly vice-president and assistant general manager, Central Arizona Light and Power Company, Phoenix, has resigned from those positions but will continue as special assistant to the president. Mr. Morairty joined the company 20 years ago as sales manager.

M. S. Barnes (A '18, M '31) formerly sales engineer, central station department, General Electric Company, San Francisco, Calif., has been made assistant manager of the central station division of the company. Mr. Barnes joined the company in Schenectady, N. Y., in 1914 after his graduation from the University of California.

H. B. Sargent (M '40) formerly vice-president and general manager, Mississippi Power and Light Company, Jackson, has resigned to become executive vice-president of the Central Arizona Light and Power Company, Phoenix. A graduate of Tulane University, Mr. Sargent had been with the Mississippi company since 1927.

E. W. Jackson (A '46) refinery electrician, Bahrein Petroleum Company, Ltd., Bahrein Island, Persian Gulf, claims the distinction of being the only member of any technical or professional society in the Persian Gulf area.

C. A. Powel (M '20, F '41) manager, headquarters engineering departments, Westinghouse Electric Corporation, East Pittsburgh, Pa., who recently served as chief of the electrical and radio branch of the Allied Control Commission in Germany has returned to the United States.

H. C. Rankin (A '29, M '34) formerly laboratory engineer of the New England Power Service Company, Providence, R. I., has been transferred to the power sales department of the Narragansett Electric Company, Providence. Mr. Rankin is a specialist in meter engineering.

J. W. Doolittle (A '26, M '33) personnel supervisor, executive department, Southern California Telephone Company, Los Angeles, has been appointed general accounting employment supervisor.

J. B. Hedley (A '34) apparatus engineer Canadian General Electric Company, Ltd., has been transferred from the Vancouver to the Victoria, British Columbia, office of the company.

W. O. Kyte (A '33) formerly lieutenant, Signal Corps, United States Army, has been made manager of the advertising and sales promotion division of the General Electric Company office in Los Angeles, Calif. Mr. Kyte was radar officer with the 9th Bombardment Division overseas.

K. E. Gould (A '36) of the transmission development department, Bell Telephone Laboratories, Inc., New York, N. Y., has been assigned to the Civil Communications Section in Tokyo, Japan, to help direct the rehabilitation of the country's war-damaged communication facilities.

E. L. Bowles (A '22, F '33) formerly professor, Massachusetts Institute of Technology, Cambridge, and special assistant to the Secretary of War, has been appointed consultant on research and development to the Automatic Electric Company.

P. H. Thayer (A '39) formerly lieutenant, United States Navy, assigned to the electronic field service group, Naval Research Laboratory, Washington, D. C., has returned to Bell Telephone Laboratories, Inc., New York, N. Y.

R. C. Disque (M '20) dean of the college of engineering and dean of the faculty of Drexel Institute of Technology, Philadelphia, Pa., recently received the honorary degree of doctor of engineering from Stevens Institute of Technology.

M. J. Kelly (M '26, F '31) executive vice-president, Bell Telephone Laboratories Inc., New York, N. Y., recently was awarded the honorary degree of doctor of science by the University of Kentucky.

J. H. Vivian (A '34, M '40) formerly protection engineer, Southern California Edison Company, Los Angeles, has been appointed electrical and maintenance engineer for the company.

W. V. Woodward (A '46) formerly power sales supervisor, Northern Indiana Public Service Company, Hammond, has become sales and application engineer with N. M. Mintz, Chicago, Ill.

L. E. Garlinghouse (A '37) formerly superintendent of the Swan Falls Power Plant, Idaho Power Company, Kuna, has been made superintendent at American Falls.

P. A. Duchastel (A '45) formerly with Ferranti Electric Ltd., Montreal, Quebec, Canada, has joined the engineering department of the Quebec Power Company, Montreal. Mr. Duchastel was graduated from McGill University in 1938.

R. W. Vonasch (A '35, M '44) formerly application engineer, federal and marine department, Ward Leonard Electric Company, Mount Vernon, N. Y., has been appointed manager of the company's newly established Newark, N. J., branch.

H. C. Lindberg (A '35) formerly of the engineering department of the Buffalo, N. Y., office of the General Electric Company, has been appointed engineer of the office.

J. T. Littleton (A '23, F '28) formerly associate director of research, Corning (N. Y.) Glass Works, has been appointed director of research. Doctor Littleton is also a vice-president of the company.

E. B. Love (A '41) formerly electrical test engineer, Consolidated-Vultee Aircraft Corporation, San Diego, Calif., has joined the California Electric Works, San Diego.

E. H. Jacobs (F '17) manufacturers' representative of Dallas, Tex., has been appointed Texas representative of the Electrical Engineers Equipment Company.

E. J. Poitras (A '33) formerly section chief, Office of Scientific Research and Development, Washington, D. C., has been elected director of engineering of Fenwal, Inc., Ashland, Mass.

E. C. Starr (M '29, F '41) professor of electrical engineering, Oregon State College, Corvallis, was selected by the National Academy of Sciences to be one of the 20 civilian scientists observing the July atomic bomb tests at Bikini atoll.

E. W. Fortune (A '41) formerly district superintendent, engineering department, Virginia Electric and Power Company, Clifton Forge, has been appointed manager of the company's Roanoke, Va., district.

W. K. Lewellen (A '37) formerly chief, contract and electrical section, First Service Command, Boston, Mass., has been appointed power sales engineer for the Lowell (Mass.) Electric Light Corporation.

J. M. Weir (A '28) formerly superintendent, Public Utility District 1, Cowlitz County, Longview, Wash. has become manager of the public utilities in Ketchikan, Alaska.

O. P. Cleaver (A '36) formerly major with the Army Engineer Board, Fort Belvoir, Va., recently was made a lieutenent colonel and director of Division II of the Board.

Scott Beamer (A '37) formerly first lieutenant in the United States Army, now is associated with Clyde Bently, San Francisco, Calif.

H. T. Bryans (A '43) formerly superindentent, Barbadoes station, Philadelphia Electric Company, Norristown, Pa., has been appointed superintendent of the company's Delaware station.

W. V. Kahler (M '39) general manager, Illinois Bell Telephone Company, Chicago, Ill., has been elected vice-president of the Western Society of Engineers.

E. W. Conway (A '30, M '44) district plant manager, Chesapeake and Potomac Telephone Company, Washington, D. C., has been appointed general plant supervisor.

O. Howarth (A '24, M '33) technical engineer, superintendent of the testing department, Lancashire Electric Power Company, Manchester, England, has been appointed sales manager and technical adviser to control all selling activities of the company.

G. R. Henninger (A '22, F '43) AIEE editor, New York, N. Y., recently was elected a director of the New York County chapter of the National Society of Professional Engineers for the 1946–48 term.

Rufus Moses (A '28, M '42) Youngstown division manager of the Ohio Edison Company, has been elected a vice-president of the company. Mr. Moses is also a director of the company.

E. H. Thompson (A '45) formerly district plant manager, Southern Bell Telephone and Telegraph Company, New Orleans, La., has been appointed Louisiana plant superintendent.

H. B. Bryans (M '17, F '18) executive vice-president, Philadelphia (Pa.) Electric Company, has been elected to the board of managers of the Western Saving Fund Society of Philadelphia.

C. F. Publow (A '17, M '26) district station engineer, Hydro-Electric Power Commission of Ontario, Toronto, Canada, has been elected president of the Royal Canadian Institute.

C. D. Coy (A '31) buildings superintendent, Cincinnati (Ohio) and Suburban Bell Telephone Company, has been appointed plant supervisor.

OBITUARY • • • •

Severn D. Sprong (A '03, M '09, F '12) consulting engineer, New York, N. Y., died June 27, 1946. Mr. Sprong was born in East Greenbush, N. Y. He completed the test course of the General Electric Company, Schenectady, N. Y., in 1893 and became superintendent of the electric department of the Consolidated Gas Company of New Jersey, Long Branch, in 1898. He was chief engineer of the Central Electric Company in New Jersey in 1900, assistant chief electrical engineer of the New York (N. Y.) Edison Company in 1902, assistant electrical engineer of the United Electric Light and Power Company in 1906, and chief electrical engineer of the Brooklyn Edison Company in 1912. From 1909 to 1912 he was chief electrical and mechanical engineer for J. G. White and Company, New York. He was officer in a number of utility companies from 1922 to 1925, the Orange County Public Service Corporation, the Orange County Hydro-Electric Corporation, the Pike County Light and Power Company, the Cape May Illuminating Company, and the Port Jervis Traction Company. He had maintained consulting offices since 1922. Mr. Sprong was an AIEE vice-president from 1912 to 1914 and a manager from 1909 to 1912. He was a member of the Society of Colonial Wars, the Sons of the Revolution, the Holland Society of New York, the St. Nicholas Society, the Engineers Club, the American Society of Mechanical Engineers, and the Edison Pioneers.

John Barclay Fisken (A '03, M '13, F '13) retired consulting engineer for the Washington Water Power Company, Spokane, and pioneer in the electrical utility industry in the Northwest, died recently. Mr. Fisken was an AIEE vice-president for 1919–1920 and a manager from 1916 to 1919. He was born in Helensburgh, Dumburtonshire, Scotland, November 2, 1861, and was graduated with First Class Honors from the City and Guilds of London Institute in 1882. His first position in the United States was superintendent for the Seattle (Wash.) Gas Company in 1886, and the following year he was manager of the Victoria (British Columbia, Canada) Electric Illuminating Company, Ltd. In 1887 he moved to Spokane Falls, Washington Territory (now Spokane, Wash.), and from 1887 to 1896 he was superintendent for the predecessors of the Washington Water Power Company—the Spokane Falls Electric Light and Power Company and the Edison Electric Illuminating Company. He was consultant for the company's first high-voltage line built between Spokane and the Coeur d'Alene mines. He was appointed chief engineer in 1918 and consulting engineer in 1920. For a number of years also he supervised the company's safety program. Mr. Fisken was a member of the Northwest Scientific Association and the Associated Engineers of Spokane.

Robert Blanchard Shepard (A '25, M, 26, F '36) chief electrical engineer, Underwriters' Laboratories, Inc., New York, N. Y., died June 20, 1946. Born in Hudson, N. Y., November 13, 1888, Mr. Shepard was graduated from Union College with the degree of bachelor of engineering in 1910. After a brief period in the switchboard department of the General Electric Company, Schenectady, N. Y., he became an inspector for the Underwriters' Association of New York State in Schenectady in 1912. He was named resident engineer in the Underwriters' Laboratories in 1913 and was transferred to New York as assistant electrical engineer in 1917. In 1922 he was titled associate electrical engineer and in 1924 was appointed chief electrical engineer. His work included contact with various technical societies, and he was a member and active committee member of the American Society for Testing Materials, the International Association of Electrical Inspectors, and the National Fire Protection Association. He served as well on many of the sectional committees of the American Standards Association.

Harry Foster Shearer (M '45) engineer in charge of test, Burlec division, Canadian Line Materials, Toronto, Ontario, died May 24, 1946. Mr. Shearer was born May 16, 1885, in Simcoe, Ontario, and was graduated from the University of Toronto with the degree of bachelor of science in 1909. From 1909 to 1913 he was associated as test engineer with the Allis-Chalmers Manufacturing Company, Cincinnati, Ohio; as design engineer with Smith, Keary, and Chace, Toronto; and as sales engineer with the Moloney Electric Company, Windsor, Ontario. He joined the staff of the Toronto Hydro-Electric System as power engineer in 1913 and became manager at Smith's Falls, Ontario, in 1917 and at Welland, Ontario, in 1922. He was made sales engineer for the Cansfield Electric Works, Toronto, in 1938 and inspector for the Canbridge Company, Ojibway, Ontario, in 1941. He entered the employ of the Canadian Line Materials in 1943.

William Corwin Burton (A '93, M '99) retired member of J. G. White and Company, New York, N. Y., died April 18, 1946, in Pasadena, Calif. Mr. Burton, who was born April 24, 1872, in Saginaw, Mich., received the degrees of bachelor of science in 1893 and electrical engineer in 1899 from the University of Wisconsin. In 1894 he joined the J. G. White organization. Mr. Burton was concerned particularly with the construction of railroads, street railway, and subway systems, in the United States as well as in Australia, New Zealand, India, Japan, and England. He was sent to London, England, in 1900, and there became director of J. G. White and Company, Ltd. He returned to New York in 1919 and until his retirement in 1934 represented British enterprises. He was president of Connett, Burton and Company from 1919 to 1928 and of the Booth American Shipping Company from 1926 to 1934.

William Requa Van Bokkelen (A '12, M '26) consulting engineer, Berkeley, Calif., died May 22, 1946. Born September 25, 1884, in Oakland, Calif., Mr. Van Bokkelen was graduated from the University of California with the degree of bachelor of science in 1906. His first position was that of draftsman and office assistant for Henry R. Worthington, San Francisco, Calif., in 1906. He was an electrician's helper with the Pacific Gas and Electric Company, San Francisco, in 1910, and in 1911 joined the Coast Counties Gas and Electric Company as assistant to the general manager. He was electrical engineer of engineering and operation from 1916 to 1919 and in 1919 was made chief engineer.

Thomas Loren Cooke, Jr. (A '41) illumination engineer, Toronto, Ontario, Canada, died May 27, 1946. Mr. Cooke was born in Rochester, N. Y., October 23, 1916, and received the bachelor of science degree from the University of Toronto in 1938 and the master of science degree from the University of Michigan in 1940. He was employed in the lighting service section of the Hydro-Electric Power Commission of Ontario, Toronto, in 1938 and 1939. From 1940 to 1945 he was a member of the equipment department of the Austin Company, Cleveland, Ohio, and worked on projects in Los Angeles, Calif., and New York, N. Y., as well as in Cleveland. During the past year he was in charge of electrical work in the building of a Navy training ship at Newport, R. I.

Philip Goldstone (M '24) engineer, Gibbs and Hill, Inc., New York, N. Y., died April 29, 1946. Mr. Goldstone, who was born February 21, 1885 in Russia, was graduated from Cooper Union in 1909 and in 1912 received the degree of civil engineer from Brooklyn Polytechnic Institute. Before joining Gibbs and Hill in 1914, he was draftsman with Viele, Blackwell, and Buck, New York. In the ensuing years most of Mr. Goldstone's work lay in the field of railroad electrification. His work progressively covered, catenary design, economic studies, and power distribution. His efforts were instrumental in obtaining for the Pennsylvania Railroad one of the first a-c calculating boards offered for sale by the manufacturer, and its operation since had been under his direction.

Shaw Hooks Hardy (A '46) manufacturers' agent, Miami, Fla., died May 26, 1946. Born November 24, 1894, in Monticello, Ga., Mr. Hardy was graduated from the Georgia School of Technology in 1917 with the degree of bachelor of science. After serving in the United States Navy, he became salesman and lighting specialist for the General Electric Company, Atlanta, Ga., from 1919 to 1925. He was also engineer for the Okonite Cable Company, Birmingham, Ala., from 1925 to 1932 and for the General Electric Supply Corporation from 1932 to 1936. In 1936 he became a manufacturers' agent, first in association with Pat Baldwin, Inc., and after 1942, independently. He was a member of the Florida Engineers Society.

Kenneth Oscar Houser (A '44) power consultant, industrial sales department, Kansas Gas and Electric Company, Wichita, died April 16, 1946. Mr. Houser, who was born in Crystal Springs, Kan., October 26, 1898, was graduated from Kansas State College in 1922 with the degree of bachelor of science. He completed the test course of the General Electric Company, Fort Wayne, Ind., in 1924 and was transferred to transformer sales in Pittsfield, Mass. He became transformer specialist engineer for the Kansas City Power and Light Company, Kansas City, Mo., in 1925 and industrial engineer for the Kansas Gas and Electric Company in 1926. He was named power consultant in 1944.

Otto Weiss (M '46) advisory engineer, Charles M. Terry Ltd., Sydney, New South Wales, Australia, died March 28, 1946. Mr. Weiss was born March 8, 1898, in Vienna, Austria, and was graduated from the Vienna Technical University in 1922. After a two-year period with the Austro-Hungarian Electric Welding Machine Company of Vienna, he entered the employ of the Elin Electric Manufacturing Company, Ltd., Vienna. With that company from 1924 to 1938, he was designing engineer, engineer in charge of the welding department, and finally chief engineer. After the Nazis occupation in 1938, Mr. Weiss went to Australia and joined the Terry company.

Henry Martin Killingsworth (A '45) manager, General Electric Company, Miami, Fla., died June 4, 1946. Mr. Killingsworth, who was born January 21, 1907, in Snellings, S. C., was graduated from Clemson Agricultural and Mechanical College in 1929 with the degree of bachelor of science. Mr. Killingsworth was with the General Electric Company in Philadelphia, Pa., from 1929 to 1936 in the test course and in commercial engineering and sales work. He was switchgear specialist in Atlanta, Ga., from 1936 to 1942 and in the latter year was transferred to Miami.

MEMBERSHIP . . .

Recommended for Transfer

The board of examiners, at its meeting of July 18, 1946, recommended the following members for transfer to the grade of membership indicated. Any objections to these transfers should be filed at once with the secretary of the Institute.

To Grade of Fellow

Berry, J. H., dist. mgr., elec. dept., Virginia Elec. & Pr. Co., Norfolk, Va.
Crowdes, G. J., asst. chief elec. engr., Simplex Wire & Cable Co., Cambridge, Mass.
Crymble, A. C., special projects engr., Tennessee Eastman Corp., Kingsport, Tenn.
Edgerton, H. E., assoc. prof. of elec. engg., Massachussetts Inst. of Tech., Cambridge, Mass.
Kahler, W. V., genl. mgr., Illinois Bell Tel. Co., Chicago, Ill.
Kistler, R. E., trans. & protection engr., Pacific Tel. & Tel. Co., Seattle, Wash.
Nikiforoff, B., chief elec. engr., Mexican Light & Pr. Co., Mexico, D. F., Mexico.
Ramadanoff, D., research elec. engr., National Carbon Co., Cleveland, Ohio.
Reukema, L. E., prof. of elec. engg., Univ. of California, Berkeley, Calif.
Yarnall, J. H., supt. of pr., Boston Elevated Ry. Co., Boston, Mass.

10 to grade of Fellow

To Grade of Member

Andrews, P. R., elec. engr. II, Tennessee Valley Authority, Knoxville, Tenn.
Badhni, J., engr. & proprietor, Badhni's, Engrs. & Contractors, Tehran, Iran.
Baker, J. R., supt. of pr., Pennsylvania Water & Pr. Co., Baltimore, Md.
Broderson, H. A., elec. engr., L. E. Kurtichanof, Cons. Engr., Portland, Oreg.
Case, N. M., design engr., General Elec. Co., Pittsfield, Mass.
Crosby, D. R., engr., Radio Corp. of America, RCA Victor Div., Camden, N. J.
Dornbush, H. W., head of distribution dept., Pennsylvania Transformer Co., Pittsburgh, Pa.
El Koshairy, M. A. B., asst. prof., faculty of engg., Fouad I, Univ., Giza, Egypt.
Elliot, W. H., supervising electronics engr., Cutler-Hammer, Inc., Milwaukee, Wis.
Evans, J. N., elec. engr. II, Tennessee Valley Authority, Knoxville, Tenn.
Few, W., mgr., electronics engg., Clark Controller Co., Cleveland, Ohio.
Gardner, M. L., supv., ind. & cent. sta. engg., Westinghouse Elec. Corp., New York, N. Y.
Gartner, C. E., Jr., junior engr., engg. lab., Philadelphia Elec. Co., Philadelphia, Pa.
Geder, G. S., elec. field & application engg., General Elec. Co., Cleveland, Ohio.
Gibson, F. L., elec. engr., West Virginia Pulp & Paper Co., New York, N. Y.
Gilliam, M. H., vice-pres. & genl. mgr., E. H. Gilliam Co., Charlotte, N. C.
Gogen, S. F., member, bd. of directors, Celik-Boya Co., Kula Textile Mills, Galata, Istanbul, Turkey.
Hurd, O. W., dist. engr., Upper Columbia Dist., Bonneville Pr. Adm., Spokane, Wash.
Johnson, V. O., engr., U. S. Rubber Co., New York, N. Y.
Johnson, W., elec. engr., 523 Heard Bldg., Phoenix, Ariz.
Jones, E. E., research assoc., Iowa State College, Ames, Iowa.
Kandoian, A. G., div. head, Federal Telecommunication Labs., New York, N. Y.
Kang, B. P., research engr., E. I. duPont de Nemours & Co., Arlington, N. J.
Klebanoff, J. H., resident elec. engr., Bureau of Yards & Docks, San Francisco Naval Shipyard, Calif.
Koehler, A. A., design engr., Standard Oil Co., Whiting, Ind.
Lind, W. J., mgr., lamp & lighting div., Canadian General Elec. Co., Vancouver, B. C., Canada.
Manwaring, A. H., exec. vice-pres. & genl. mgr., Philadelphia Elec. & Mfg. Co., Philadelphia, Pa.
Marple, C. N., div. engr., Iowa Public Service Co., Sioux City, Iowa.
McCollum, T. A., engr., Oklahoma Gas & Elec. Co., Ardmore, Okla.
McCormick, H. T., asst. elec. engr., U. S. Bureau of Reclamation, Denver, Colo.
Mikos, J. J., engr., Westinghouse Elec. Corp., East Pittsburgh, Pa.
Milner, C. K., genl. plant mgr., Ohio Bell Tel. Co., Cleveland, Ohio.
Neiman, W. N., dev. engr., General Elec. Co., Pittsfield, Mass.
Nevin, P. P., div. supt. of substations, Southern Calif. Edison Co. Ltd., Alhambra, Calif.
Pappu, V., officer on special duty with gov. of India, c/o Franklin Park Hotel, Washington, D. C.
Peterson, W. L., application engr., Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Pettit, J. M., supervising engr., Airborne Instruments Lab., Inc., Mineola, N. Y.
Phillips, C. S., motor engr., Emerson Elec. Mfg. Co., St. Louis, Mo.
Ramaswami, H. K., dy. superintending engr., South Madras Elec. Supply Co., Trichinopoly, S. India.
Ray, W. O., elec. engr. & supt. of maintenance, Todd Houston Shipbuilding Corp., Houston, Tex.
Ringer, F. W., elec. engr., Interstate Oil Pipe Line Co., Shreveport, La.
Rohwer, O. J., elec. engr., Sargent & Lundy, Chicago, Ill.
Rummel, E. T., sales engr., Hertner Elec. Co., Cleveland, Ohio.
Saunders, R. M., instructor, Univ. of Minnesota, Minneapolis, Minn.
Snedeker, M. L., asst. chief engr., The Radiart Corp., Cleveland, Ohio.
Sparling, T. E., elec. engr., asst. to ind. mgr., U. S. Navy, Seattle, Wash.
Stainken, H. A., Sr., design engr., Otis Elevator Co., New York, N. Y.
Storer, S. B., managing engr., Trumbull Elec. Mfg. Co., Norwood, Ohio.
Thomas, J. D., elec. engr., Reynolds, Smith & Hills, Jacksonville, Fla.
Tracy, G. F., prof. of elec. engg., Univ. of Wisconsin, Madison, Wis.

Vaile, R. B., Jr., sr. physicist & consultant, Armour Research Foundation, Chicago, Ill.
Weaver, C. E., sr. elec. engr., Eastman Kodak Co., Rochester, N. Y.
White, R. V., field engr., General Elec. Co., Dayton, Ohio.
Wisner, R. R., asst. chief elec. engr., Stone & Webster Engg. Corp., Boston, Mass.
Woodling, G. V., patent attorney, 1340 Union Commerce Bldg., Cleveland, Ohio.
Wright, T. C., pres., Otter Tail Power Co., Fergus Falls, Minn.

56 to grade of Member.

Applications for Election

Applications have been received at headquarters from the following candidates for election to membership in the Institute. Any member objecting to the election of any of these candidates should so inform the secretary before September 21, 1946, or November 21, 1946, if the applicant resides outside of the United States or Canada.

To Grade of Fellow

Wade-Cooper, F., General Elec. Co. (India), Ltd., Calcutta, India.

1 to grade of Fellow

To Grade of Member

Allen, D. H., Revere Copper & Brass, Baltimore, Md.
Arthur, F. C., Kansas State Corp. Comm., Topeka, Kans.
Baldwin, L. W., U. S. Navy Electronics Lab., San Diego, Calif.
Barabas, J. J., Thermoid Co., Trenton, N. J.
Baty, E., The Bell Tel. Co. of Canada, Montreal, Canada.
Bird, D. E., Edmundsons Electricity Corp. Ltd., London, England.
Brown, W. C., SC Engineering Labs., Bradley Beach, N. J.
Browning, L. P., Florida Pr. & Lt. Co., West Palm Beach, Fla.
Davenport, J. F., Southern Calif. Edison Co., Ltd., Los Angeles, Calif.
Eby, J. B. (Re-election), Amer. Tel. & Tel. Co., Philadelphia, Pa.
Feldt, R., Allen B. DuMont Laboratories, Inc., Passaic, N. J.
Fletcher, C. W., Charles T. Main, Inc., Boston, Mass.
Hnilicka, M. P., Czechoslovak Synthetic Motor Fuel Works, Most, Czechoslovakia.
Koch, J. F., Jr., University of Pennsylvania, Philadelphia, Pa.
Krips, J. A. C., I.T.E. Circuit Breaker Co., Philadelphia, Pa.
Lynskey, J. P., Commonwealth Edison Co., Chicago, Ill.
Maddox, C. H., Radio Station KTBS, Shreveport, La.
Mason, C. J. M., General Motors-Holdens Ltd., Melbourne, Australia.
Minshull, J. A., Boeing Aircraft, Seattle, Wash.
Moorhouse, C. E., University of Melbourne, Melbourne, Australia.
Nadkarni, P. S., University of Washington, Seattle, Wash.
Nordell, R., Sieverts Kabelverk, Sundyberg, Sweden.
Ogle, W. H., Todd Shipyards Corp., Seattle, Wash.
Parsegian, V. L., Portable Products Corp., Brooklyn, N. Y.
Perkinson, T. F., General Elec. Co., Erie, Pa.
Relli, E. D., Chas. T. Main, Boston, Mass.
Rose, M. C., The Chesapeake & Potomac Tel. Co., Baltimore, Md.
Rosol, M. F., Gilbert Associates, Inc., Reading, Pa.
Shahan, J. H., Tampa Shipbuilding Co., Inc., Tampa, Fla.
Sharpe, E. W., Ernest J. Kump, San Francisco, Calif.
Singh, S., Punjab Govt., Lahore, India.
Sontum, W. C. (Re-election), Penna. Elec. Co., Johnstown, Pa.
Strickenburg, W. P., Meadville Tel. Co., Meadville, Pa.
Sutton, R. C., Pittsburgh Railways Co., Pittsburgh, Pa.
Wambach, A. G., N. Y. Telephone Co., Brooklyn, N. Y.
Weise, W. R., Cincinnati Gas & Elec. Co., Cincinnati, Ohio.
West, H. J., Penna. Pr. & Lt. Co., Allentown, Pa.
Williams, B. J., Newton Bros. (Derby) Ltd., Derby, England.

38 to grade of Member

To Grade of Associate

United States

1. North Eastern

Anzivino, L. D., Stone & Webster Engineering Corp. Boston, Mass.
Bowman, J. A., American Tel. & Tel. Co., Buffalo, N. Y.
Brennan, J. J., Southern New England Tel. Co., Hartford, Conn.
Griffin, D. H., Raytheon Mfg. Co., Waltham, Mass.
Leathers, C. B., General Elec. Co., Providence, R. I.
Martel, C. W., Raytheon Mfg. Co., Newton, Mass.
McIntosh, R. W., 22 W. Wyoming Ave., Melrose, Mass.
O'Connor, R. J., Eastman Kodak Co., Rochester, N. Y.
Pashoogian, S. J., 570 Chestnut St., Lynn, Mass.
Ronan, F. D., Jackson & Moreland, Boston, Mass.
Sanders, J. L., General Elec. Co., Schenectady, N. Y.
Talleur, R. B., Central Hudson Gas & Elec. Corp., Poughkeepsie, N. Y.
True, W. F., Jr., 41 Mechanic St., Foxboro, Mass.
Turitzin, N. M., General Elec. Co., Schenectady, N. Y.

2. Middle Eastern

Althouse, J. W., Jr., Philadelphia Elec. Co., Philadelphia, Pa.
Biscup, C. J., Westinghouse Elec. Corp., East Pittsburgh, Pa.
Bousky, S., Jack & Heintz Precision Industries, Inc., Maple Heights, Ohio.
Casanova, L. A., Westinghouse Elec. Corp., East Pittsburgh, Pa.
Chiazza, A. C., Westinghouse Elec. Corp., Lima, Ohio.
Emmert, L. R., Westinghouse Elec. Corp., Washington, D. C.
Farmery, B. L., Bra Bon Elec. Co., Philadelphia, Pa.
Gimse, D. R., Navy Dept., Bureau of Ships, Washington, D. C.
Gmeiner, J. B., B. F. Goodrich, Akron, Ohio.
Henderson, J. R., General Elec. Co., Erie, Pa.
Hennessy, J. D., Publicker Industries, Inc., Philadelphia, Pa.
Isbell, J. E., Westinghouse Elec. Corp., East Pittsburgh, Pa.
Kay, A. F., Jack & Heintz Precision Industries, Inc., Cleveland, Ohio.
McIlroy, J. H., Gen. Elec. Co., Philadelphia, Pa.
Mitwalli, A. H., Egyptian Education Mission, Washington, D. C.
Merwin, R. E., University of Pennsylvania, Philadelphia, Pa.
O'Neal, M. B., Westinghouse Elec. Corp., East Pittsburgh, Pa.
Rhudy, R. G., General Elec. Co., Philadelphia, Pa.
Rueckert, J. J., Consolidated Gas, Elec. Lt. & Pr. Co., Baltimore, Md.
Samartino, R. F., 12 Garfield Ave., Collingswood, N. J.
Stehman, J. D., Capital Transit Co., Washington, D. C.
Wasmund, J. A., Westinghouse Elec. Corp., East Pittsburgh, Pa.

3. New York City

Barber, W. H. (Re-election), Standard Oil Development Co., Elizabeth, N. J.
Cammisa, M. A., National Elec. Mfgrs. Assn., New York, N. Y.
Campbell, E. O. (Re-election), Federal Tel. & Radio, Clifton, N. J.
DeAcutis, O., Lt. U.S.M.C.R., 1772 E. 172nd St., New York, N. Y.
DeLano, R. W., Jr., Sperry Products, Inc., Hoboken, N. J.
Doehne, R., Public Service Elec. & Gas Co., Newark, N. J.
Glueckler, E. J., Fairchild Camera & Instrument Corp., Jamaica, N. Y.
Levitt, E., Lt. (jg) USNR, 93 Lakeside Drive, Baldwin, N. Y.
Levy, R. J., Arma Corp., Brooklyn, N. Y.
Littlefield, R., Jr., E. I. duPont, Grasselli, N. J.
Murphy, E. J., Lieut., USNR, 36 Kings Rd., Chatham, N. J.
Rolnik, S., 20 E. 18th St., Brooklyn, N. Y.
Shepherd, R. L., Public Service Elec. & Gas Co., Newark, N. J.

4. Southern

Barnes, I. M., Jr., Tennessee Valley Authority, Chattanooga, Tenn.
Barney, J. M. (Re-election), N.A.C.A., Langley Field, Va.
Bevis, J. M., Tennessee Eastman Corp., Oak Ridge, Tenn.
Bishop, J. R., Mutual Boiler Insurance Co., Spartanburg, S. C.
Burnett, W. C., Southern Bell Tel & Tel. Co., Charlotte, N. C.
Cline, J. T., Carbide & Carbon Chemicals Co., Oak Ridge, Tenn.
Greagan, J. J., Jr., Alabama Pr. Co., Birmingham, Ala.
Noble, H. P., Jr., Virginia Elec. & Pr. Co., Norfolk, Va.
Patton, H. S., Carbide & Carbon Chemical Corp., Oak Ridge, Tenn.
Prescott, B. W., Alabama Pr. Co., Birmingham, Ala.
Rader, J. F., Jr., Columbia Elec. Repair Co., Columbia, S. C.
Randolph, C. R., Florida Pr. & Lt. Co., West Palm Beach, Fla.
Rutherford, J. B., Howard M. Patterson, Decatur, Ga.
Warren, A. L., Southwestern Gas & Elec. Co., Shreveport, La.
Whitmore, C. W., Jr., 1726 S. W. 19th Ave., Miami, Fla.

5. Great Lakes

Bartha, S. J., Automatic Elec. Co., Chicago, Ill.
Bonney, R. H., Caterpillar Tractor Co., Peoria, Ill.
Brown, C. W., Gen. Elec. Co., Fort Wayne, Ind.
Clapp, L. R., AC Spark Plug Div. of G.M.C., Flint, Mich.
Cummings, W. J. (Re-election), Public Service Co. of Indiana, Inc., Indianapolis, Ind.
Dietz, G. E., 2468 West Auer Ave., Milwaukee, Wis.
Gaston, E. E., Sun-Kraft, Inc., Chicago, Ill.
Holmes, T. W., Minn. Pr. & Lt. Co., Duluth, Minn.
Jeffries, A. W., Wisconsin Pr. & Lt. Co., Baraboo, Wis.
Kolon, E. C., Colonial Elec. Co., Detroit, Mich.
Laskin, S., Minn. Pr. & Lt. Co., Duluth, Minn.
Lochard, G. M., Illinois Pr. Co., Decatur, Ill.
Mierendorf, R. C., Square D Co., Milwaukee, Wis.
McElroy, J. O., Minn. Pr. & Lt. Co., Duluth, Minn.
Oberlander, E. B., Oberlander Elec. Co., Peoria, Ill.
Pettit, G. A., Sargent & Lundy, Chicago, Ill.
Rose, D. A., Electronic Service Co., Flint, Mich.
Spurbeck, G. B., Minn. Pr. & Lt. Co., Duluth, Minn.
Taylor, J. E., Allis-Chalmers Mfg. Co., West Allis, Wis.
Thatcher, J. D., Electronic Service Co., Flint, Mich.
Tibbetts, C. H., Minn. Pr. & Lt. Co., Duluth, Minn.
Turnquist, A. A., Minn. Pr. & Lt. Co., Duluth, Minn.
Votaw, E., Oliver Corp., South Bend, Ind.

6. North Central

Ballard, R. R., Public Service Co. of Colo., Denver, Colo.
Carpenter, E. K., Public Service Co. of Colo., Denver, Colo.
Lappi, T., U. S. Bureau of Reclamation, Denver, Colo.

7. South West

Chandlee, J. M. (Re-election), Century Elec. Co., St. Louis, Mo.
Davis, L. K., Fisk Elec. Co., Houston, Tex.
Houston, C. E. (Re-election), Texas Tech. College, Lubbock, Tex.
Huckins, G. J., Western Elec. Co., Dallas, Tex.
Roberts, B. W., 500 North 10th, Frederick, Okla.
Welborn, R., Jr., J. & J. Armature Works, Beaumont, Tex.

8. Pacific

Andrews, M. J., Dept. of Water & Pr., Los Angeles, Calif.
El-Sum, H., Calif. Institute of Tech., Pasadena, Calif.
Feldman, S., Douglas Aircraft, Santa Monica, Calif.
Ferguson, A. E., Headman, Ferguson & Carollo, Phoenix, Ariz.
Goggin, T. M., Placer Management, Ltd., San Francisco, Calif.
Haruff, G. E., Pacific Gas & Elec. Co., Emeryville, Calif.
Olson, O. E., Ensign, U.S.N., USS *Duluth*, c/o F.P.O., San Francisco, Calif.
Paine, O. S., Modesto Irrigation District, Modesto, Calif.
Rowland, W. H., Western Pipe and Steel, South San Francisco, Calif.
Sattro, R. L., Sr., Consolidated-Vultee Aircraft Corp., San Diego, Calif.
Wartena, R. S., Oakland Army Base, Oakland, Calif.

9. North West

Edwards, D. E., Seattle Light Dept., Seattle, Wash.
Fletcher, J., General Cable Corp., Seattle, Wash.
Hughes, R. C., Hughes Elec. Co., Spokane, Wash.

Elsewhere

Bhowmic, M. C., Cooch Behar State, Bengal, India.
Dalen, G., Aga-Baltic AB, Lidingo, Sweden.
Dalmau M., L., The Mexican Lt. & Pr. Co., Ltd., Mexico D. F., Mexico.
Dehnugara, P. P., The English Elec. Co., Ltd., Fort, Bombay, India.
Dmitrieff, N. I., Shanghai Pr. Co., Shanghai, China.
Flindt, C. B., RAF Station, Melksham, Wiltshire, England.
Kuys, A., Modder East Gold Mine Ltd., Transvaal, South Africa.
Lundbaeck, N. T., Sydsvenska Kraftaktiebolaget, Malmo, Sweden.
Mackey, P. J., 40 Leeson Park, Ballsbridge, Dublin, Ireland.
Marshall, R. V., Messrs. Newton Bros. (Derby) Ltd., Derby, England.
Mehta, B. D., The Darbhanga Laheria Serai Elec. Supply Corp., Ltd., Darbhanga, Bihar, India.
Padmanabhan, R., Vincent Radio Engineering College, Trichinopoly, So. India.
Pereira, T. B., Fertilizers and Chemicals, Ltd., Alwaye, Travancore, S. India.
Rodriguez, R., P. O. Box 67, San Juan, Puerto Rico.
Vinogradov, N. A., Shanghai Pr. Co., Shanghai, China.
Williams, D., South Porto Rico Sugar Co., Ensenada, Puerto Rico.

Total to grade of Associate
United States, 110
Elsewhere, 16

OF CURRENT INTEREST

Engineering Societies Library Describes Services Offered

As part of his efforts to give needed publicity to the unique research facilities latent in the Engineering Societies Library in New York, N. Y., Ralph H. Phelps, acting director of the library, addressed the meeting of officers, delegates, and members at the AIEE summer convention in Detroit. He stressed the fact that, as the foremost engineering library in the United States, its services are available to engineers throughout the United States, whether or not they are members of a Founder Society, and whether or not they can visit the library.

In this same connection the library has issued a pamphlet describing and explaining in detail the services it provides for those desiring technical information.

READING ROOM

Anyone may visit the free reading room and use all the resources of the library. A trained staff is ready to help the reader and to direct him to the best sources, so that he will not waste time in aimless searching. The reading room opens at 10 a.m. weekdays. Mondays to Fridays it closes at 10 p.m. and Saturdays at 6 p.m., except during the summer, when it closes at 5 p.m. every day. It is closed on Sundays and most legal holidays.

SERVICE BUREAU

Distance and lack of time prevent many from coming to the library. To serve these persons, a specially trained staff is available to make literature searches, translations, and copies of library material. All services are rendered at cost.

Searches. The service bureau handles questions on any engineering subject that can be answered by consulting the existing technical literature. This service ranges from recommending books on a specific subject to the preparation of comprehensive annotated bibliographies. The original publication, if available in the library, is examined and is listed only if it is pertinent to the search. Literature searches are made for all purposes including that of disclosures related to patents.

Searches are undertaken to suit the exact specification of the inquirer. To do this the searchers must know:

1. The subject, stated as exactly as possible with indication of those phases to be included and those, if any, to be excluded. Should the subject be covered very thoroughly, or will a less complete search suffice?
2. Period of time to be covered.
3. Is the search to cover materials in all languages or only in English? Is it to be restricted to material from any country or countries?

The charge for searching is $2.50 per hour, except to members of a Founder Society. On request, the cost of covering a given field for a given period will be estimated, if the nature of the search makes this possible. A charge is made only for the time used.

Translations. The rates charged per hundred words for English translations of technical articles of ordinary difficulty are:

German, French, Dutch, Italian, Spanish	$1.00
Russian, Polish, Portuguese, Danish, Swedish, etc.	1.20
Japanese	3.00

A small additional charge will be made for the extra time required for articles that contain a high proportion of formulas or other difficult material. The cost of any translation will be estimated if requested, but time can be saved by indicating in letters of inquiry the amount you are willing to pay. If this is sufficient to cover the cost, the work of translating can begin at once. The cost will be the same whether or not an estimate is supplied, as the work is done at cost.

Photostats and Microfilm. Photostatic copies of material in the library can be supplied for 30 cents a print. This price is for 11 by 14 inch, white on black (negative) prints. Any two facing pages which together measure not over 11 by 14 inches can be taken on one print. Larger material will require one print per page. Black on white (positive) prints cost an additional 30 cents each. Reductions or enlargements can be supplied.

Microfilm is economical for copying long articles; photostating is generally preferable for short ones. As most technical articles are short, the library does not have equipment for microfilm copying, but by arrangement with another organization, the library can supply microfilm copies of its material. Any one article from a magazine can be supplied for $1.50, regardless of the length of the article.

Payment for Services. As all services are rendered at cost, payment in advance is requested when the exact cost of the work is known. Invoices will be sent when payment in advance is impracticable.

SPECIAL RATES AND SERVICES FOR MEMBERS OF THE FOUNDER SOCIETIES

The Engineering Societies Library is supported largely through the allotment of a portion of the dues of the members of the Founder Societies (American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, and the AIEE). For this reason individual members of these societies receive special rates on services, and they may borrow library books. Minor requests from members are handled without charge. All other services of the library are also available to members.

Rates. Members of the Founder Societies who order work for their personal use and pay by personal check will receive:

1. A discount of 20 per cent on searches.
2. A discount of 20 per cent on translations.
3. A reduction of 5 cents on each photostat print.

Loans of Books. Because the library's material is valuable and much of it in frequent demand, the library board has established the following rules governing the loan of books:

1. Books, including bound serial publications, may be borrowed by any member of a Founder Society, if he is in good standing and residing in the continental United States or Canada. (Applicants are asked to name their society affiliation.)
2. A charge of 25 cents a week, or fraction of a week, will be made for each volume borrowed.
3. The maximum length of time for any loan is two weeks, not counting time in transit.
4. Members may have as many as three volumes on loan at one time.
5. Return postage and insurance must be paid by the borrower.
6. Rare books and reference books are lent only after approval by the library board.

Requests should be addressed to the Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.

60-Cycle Power Reaches Rumford, Me.

A historic "last" is claimed by the Rumford Falls Light and Water Company, Rumford, Me., in announcing the impeding conversion of its domestic electricity supply from 40-cycle to 60-cycle power. It claims to be the last company in the United States to make the change, which will affect 5,000 customers.

The 60-cycle conversion was not made previously, because the Rumford Falls Light and Water Company takes only four per cent of the output of the Rumford Falls Power Company, while the remaining 96 per cent goes to the Oxford Paper Company which will continue to use 40-cycle power.

Complete conversion will require an estimated 36 months at a cost of approximately $500,000. A consumer survey is being conducted by mail in order to determine what electric appliances in homes will need to be converted to use the new current. The company plans to convert such appliances at no charge to its customers or to make allowances for 40-cycle appliances on the purchase of new appliances.

Engineers' Co-operation Sought in Economics Status Survey

In a self-analysis of unprecedented magnitude, America's engineering profession in co-operation with the United States Department of Labor's Bureau of Labor Statistics, is conducting a survey on the economic status of the nearly 100,000 members of the societies comprising Engineers Joint Council—the American Institute of Chemical Engineers, the AIEE, the American Institute of Mining and Metallurgical Engineers, the American Society of Civil Engineers, and the American Society of Mechanical Engineers. The National Society of Professional Engineers also is participating in the survey.

Calling for information which can be supplied readily and simply, the questionnaire is being mailed to each member of the participating engineering bodies, together with an explanatory letter signed by Ewan Clague, Commissioner of Labor Statistics. Replies will be tabulated by code on machines in the Bureau which are designed especially for such work.

The questionnaire is accompanied by an addressed envelope for the convenience of recipients.

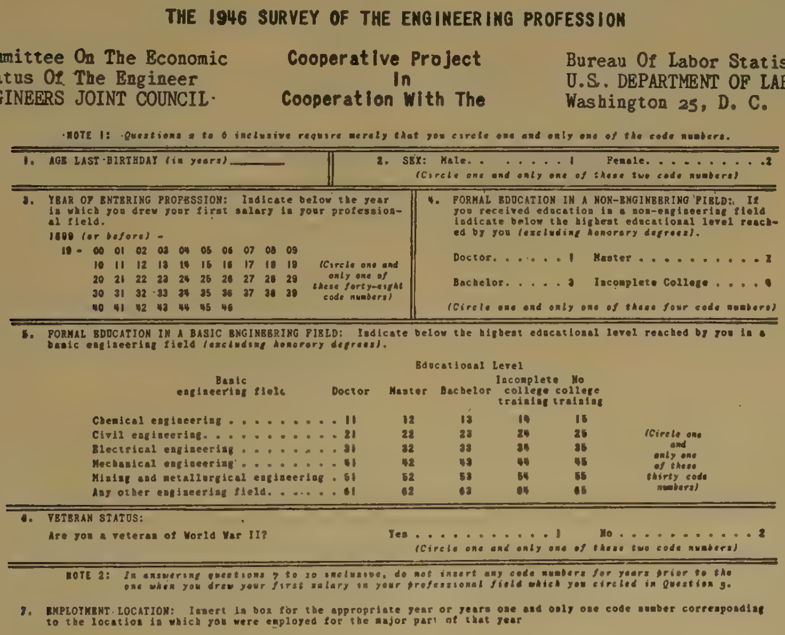
The physical conduct of the survey is in the hands of the Bureau of Labor Statistics, which is equipped to handle this type of precoded questionnaire, in which participants remain anonymous. The committee has engaged as consultant and liaison with the Bureau, Andrew Fraser, Washington, D. C., who prepared a comprehensive report on a similar survey conducted by the Bureau in 1935.

An up-to-date foundation for evaluating the educational needs and professional opportunities of the engineering profession is the objective of the survey, which is under way after more than a year of preparation and study. The undertaking is sponsored by Engineers Joint Council's Engineer Survey Committee, a subcommittee of the EJC Committee on the Economic Status of the Engineer. Colonel William N. Carey, executive secretary of ASCE, is chairman.

The committee urges each engineer to answer the questions completely; and to do it as soon as the questionnaires are received.

Emphasis is placed on the need for complete and correct responses to the questionnaire, since anonymity makes checking impossible, and incompleteness, even of one question, automatically excludes all other data in the question from tabulation.

A deadline for receipt of completed questionnaires has been set for November 15, after which Mr. Fraser will proceed with preparation of a report based on the replies. Each member is requested to give the matter immediate attention.



THE 1946 SURVEY OF THE ENGINEERING PROFESSION

Committee On The Economic
Status Of The Engineer
ENGINEERS JOINT COUNCIL

Cooperative Project
In
Cooperation With The

Bureau Of Labor Statistics
U.S. DEPARTMENT OF LABOR
Washington 25, D. C.

NOTE 1: *Questions 1 to 6 inclusive require merely that you circle one and only one of the code numbers.*

1. AGE LAST BIRTHDAY *(in years)* ________

2. SEX: Male. . . . . 1 Female. 2
(Circle one and only one of these two code numbers)

3. YEAR OF ENTERING PROFESSION: Indicate below the year in which you drew your first salary in your professional field.
1899 *(or before)* –
19 – 00 01 02 03 04 05 06 07 08 09
10 11 12 13 14 15 16 17 18 19
20 21 22 23 24 25 26 27 28 29
30 31 32 33 34 35 36 37 38 39
40 41 42 43 44 45 46
(Circle one and only one of these forty-eight code numbers)

4. FORMAL EDUCATION IN A NON-ENGINEERING FIELD: If you received education in a non-engineering field indicate below the highest educational level reached by you *(excluding honorary degrees)*.
Doctor. . . . . . . 1 Master 2
Bachelor. . . . . 3 Incomplete College 4
(Circle one and only one of these four code numbers)

5. FORMAL EDUCATION IN A BASIC ENGINEERING FIELD: Indicate below the highest educational level reached by you in a basic engineering field *(excluding honorary degrees)*.

Basic engineering field	Doctor	Master	Bachelor	Incomplete college training	No college training	
	Educational Level					
Chemical engineering	11	12	13	14	15	
Civil engineering.	21	22	23	24	25	*(Circle one and only one of these thirty code numbers)*
Electrical engineering	31	32	33	34	35	
Mechanical engineering	41	42	43	44	45	
Mining and metallurgical engineering .	51	52	53	54	55	
Any other engineering field.	61	62	63	64	65	

6. VETERAN STATUS:
Are you a veteran of World War II? Yes . . . . 1 No 2
(Circle one and only one of these two code numbers)

NOTE 2: *In answering questions 7 to 10 inclusive, do not insert any code numbers for years prior to the one when you drew your first salary in your professional field which you circled in Question 3.*

7. EMPLOYMENT LOCATION: Insert in box for the appropriate year or years one and only one code number corresponding to the location in which you were employed for the major part of that year

MR. ENGINEER—Do not fail to answer this questionnaire, which should be reaching you in the mail any day now, if you have not received it already. It is not "just another government questionnaire." It is a study being made by YOUR society and paid for in part by YOUR dues. The questionnaire comes to you from the United States Department of Labor's Bureau of Labor Statistics because that bureau, which is equipped to conduct and tabulate the findings of such coded surveys, is co-operating with the AIEE and other engineering societies in this task of evaluating the economic status of the engineer in 1946

Enemy Air Equipment Exhibited at Wright Field

To facilitate the exploitation of captured enemy aeronautical equipment and data, the United States Air Technical Intelligence has arranged a symposium for September 9 to 13 at Air Matériel Command headquarters, Wright Field, Dayton, Ohio.

The meeting is one of a series intended to give representatives of American industry, agencies, and institutions opportunity to participate in technical studies, discussions, and close-up inspections of equipment in which they are particularly interested.

Most of the equipment exhibited at the meetings is available for loan in exchange for technical reports on studies and tests made by the beneficiaries. Air Technical Intelligence disseminates all available pertinent information, in accordance with the Government's co-ordinated program covering all types of captured information and equipment.

The Equipment Symposium, as the September meetings are termed officially, has been organized and will be conducted by the equipment section, analysis division. In order that visitors may budget their time, sessions have been scheduled under the following dates and general headings:

September 9—Instrument and navigation and electric (not electronic) equipment.

September 10—Mechanical and ground (handling) equipment, aeronautical materials.

September 11—Personal equipment.

September 12—Aeromedical equipment.

September 13—Photographic equipment.

Inspections will precede and follow lecture–discussion periods, and procurement procedures will be explained. Tours of the flight line also will be arranged. Displays are in charge of the receiving and storage section, collection division.

Equipment in the following categories will be discussed and examined under guidance of intelligence personnel and visiting experts:

Instrument and Navigation Equipment

Autopilots.
Compasses (magnetic and remote indicating).
Chronometers.
Indicators (air speed, rate of climb, bank and turn).
Gauges (pressure, vacuum, hydraulic) and signal assemblies.
Gauges (for fuel level, water, and oil).
Thermometers.
Watches.
Tachometers, tachometer generators.
Thermocouples.
Voltmeters.
Sextants.
Astro and pocket compasses.
Fuel mixture indicators and analysis cells.
Indicators, position (landing gear and flap).
Computers (except armament).
Navigation kits.

Electric Equipment

Generators, starters, inverters, convertors.
Motors and alternators.
Test and maintenance equipment.
Batteries, power cable, connectors.
Lightning equipment, aircraft and airdrome.

Powerful Traveling Wave Tube Developed

Developed by Bell Telephone Laboratories, Inc., this new vacuum tube amplifier is expected to have widespread applications in long-distance telephony, especially in microwave radio-relay systems, and in television transmission. The tube promises to amplify voice or television signals over a frequency band 40 times as wide as that of the best tube now in use and to give many times the amplification. A little more than a foot long and a few inches wide, the tube contains a coil of thin wire running the length of the stem. The wave to be amplified is fed onto this coil at the bulb end and drawn off at the other end. The idea underlying the traveling wave tube was conceived by R. Kompfner of the Clarendon Laboratories at Oxford University and the electronic problems were solved by J. R. Pierce and L. M. Field of Bell Laboratories

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Protective devices for electric equipment.
Electric system control devices.

Mechanical and Ground Handling Equipment
Aircraft heating and ventilating equipment.
Anti-icing and deicing equipment.
Maintenance stands and allied equipment.
Pressurized cabin equipment, including regulators, cabin superchargers.
Power and hand tools.
Auxiliary power plants, generators, battery carts.
Portable and fixed aircraft fire extinguisher equipment.
Compressed air and internal combustion starters.
Precision measuring equipment (except optical).

Materials
Metals and metal working.
Radiographic and magnetic inspection.
Rubber (natural and synthetic).
Vibration absorbers.
Leather.
Forgings, castings.
Corrosion control.
Bearings (ball and sleeve).
Plastics and resins.
Chemicals.
Wood.
Metallurgy and plating.
Welding and welding materials.
Adhesives.
Paints and dyes.
Textiles.
Ceramics.

Personal Equipment
Parachutes.
Flying clothing (including electrically heated suits).
Arctic, jungle, sea, and land rescue equipment, life rafts, vests, accessories.
Aerial delivery containers and equipment.

Bell System Expands Mobile Service Plans

Applications have been filed with the Federal Communications Commission by the American Telephone and Telegraph Company for authority to construct transmitter–receivers for mobile radiotelephone service along the highways between Washington and New York; Buffalo and New York, via Albany; and Los Angeles and San Diego. Construction on similar installations already has been started between New York and Boston and between Chicago and St. Louis. When completed and licensed, the systems will provide radiotelephone service to properly equipped cars, trucks, busses, boats, and trains operating anywhere along or near the entire route.

On the New York–Washington highway, it is planned to build stations near New Brunswick, Philadelphia, Wilmington, Baltimore, and Washington, as an extension of the Boston to New York system. On the New York–Albany–Buffalo route, stations are to be located near White Plains, Poughkeepsie, Albany, Fonda, Utica, Syracuse, Rochester, and Buffalo. Between Los Angeles and San Diego, transmitter–receivers will be erected on Mount Wilson and Mount Woodson.

Applications for Bell System highway mobile radiotelephone installations in a number of other cities are pending or in preparation. Those communities include Cleveland, Columbus, Lansing, Saginaw, Grand Rapids, Rockford, Knoxville, Chattanooga, Charleston, Savannah, Jacksonville, Montgomery, Mobile, Baton Rouge, Shreveport, Little Rock, Tulsa, and Austin. Although these stations will operate initially as separate installations serving only vehicles in and around each community, they are expected eventually to become links in mobile radiotelephone systems on important through highways.

Telephone calls to and from vehicles will travel part way by radio and part way by wire, each transmitter–receiver being linked by wire with a telephone central office. A man in New York, for example, who wants to call a mobile unit en route between New York and Washington will dial "long distance" and ask for the mobile service operator, to whom he will give the telephone number of the vehicle and its estimated location. The call will be routed over telephone wires to the operator at the transmitting station nearest the car or truck. In a similar manner, a call may be placed from a vehicle to any telephone, or between two vehicles.

Navy Reveals War Use of Infrared Telescopes

Telescopes constructed around the same infrared image tube as the sniperscope and the snooperscope (*EE, June '46, p 295*) were employed by the United States Navy during the war to make night landings on beaches bathed with infrared floodlights and for signaling after dark. The telescopes, upon which development was started in the early 1930's, were manufactured by the Radio Corporation of America.

On August 25, 1942, the various applications of infrared equipment were tested in a complete amphibious landing operation staged off Solomon's Island, Md. Signaling by use of marker lights and identification lights, and reconnaissance by means of large infrared searchlights, were demonstrated. In later demonstrations it was shown that it is possible to see a shore line and buildings along a coast and to detect trucks, tanks, and other large vehicles. This and other Navy tests established the infrared electron telescope as a practical weapon of war.

As the sensitivity of the tubes and telescopes was improved, the RCA company perfected complete portable units consisting of a small spotlight and a hand-borne infrared telescope, which were used by the Navy in many applications.

In addition to the uses found for infrared by the Navy, other wartime applications of the electron telescope include the marking of landing places for paratroopers by members of the advance party, and the spotting of camouflage nets and other devices deceptive to the unaided human eye.

Infrared peacetime applications include burglar alarms, microscopy, spectroscopy, examination of undeveloped film in total darkness, and special undercover work in connection with police investigation and apprehension of criminals.

Static Electricity From Snow Is Air Communication Hazard

The breaking up of snowflakes into minute particles as they strike an airplane in flight creates sufficient static electricity to account for the interruption of radio voice communication between an airplane and the ground, one of the greatest hazards of flying in a snow storm, according to the results of a study made by Vincent J. Schaefer of the General Electric Company, Schenectady, N. Y.

Experiments have shown that snowflakes do not follow the air-flow pattern of an airplane in flight, but instead hit the airplane and break into from 30 to 500 fragments. On breaking up they produce the static electricity which drowns out all other radio signals.

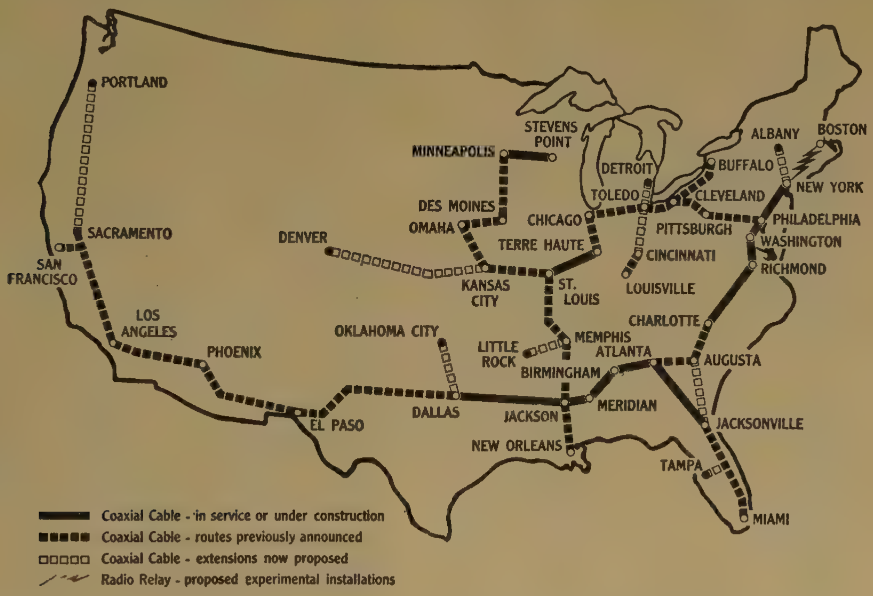
Snowflakes generally are classified into two types based on the atmospheric electric effects which occur during snow storms. A positive electric charge is associated with crystal forms of dry snow which make up cirrus clouds. Both positive and negative electricity are associated with a snow storm characterized by wet stellar crystals often coated heavily with rime, ice needles, graupel, sleet, and powder snow.

A comparison was made of the amount of electricity carried by the snow from the sky and the amount created by friction when the snow particles are broken up, showing that on an average a snow crystal carries a charge equivalent to 17,500 electrons. The fracture of the crystal raises this average charge by more than a hundred times in some instances.

FPC Compiles Electric Rates for 1945. The Federal Power Commission has issued its 12th annual publication showing, in the form of typical net monthly bills, electric rates as of January 1, 1946, for residential, commercial light, commercial power, and industrial service in 204 United States cities having populations of 50,000 and more. If the population of these cities plus the population of communities served under identical rates is taken into account, the data presented are applicable to about 75 per cent of the electric customers living in communities of 250 population and more. The report, R-31, is priced at 25 cents a copy and may be obtained from the Federal Power Commission, Washington 25, D. C.

16 Millimeter Films Shown in Hollywood. Regular showings of feature length motion pictures in 16 millimeter size recently were inaugurated at the Marcal Theater in Hollywood, Calif. Projection room installations, manufactured by the Bell and Howell Company, Chicago, Ill., were dual 16 millimeter Filmoarc machines. The pictures were reproduced on a standard 16 by 22 foot theater screen with a projection throw of 123 feet.

Bell System Network for Television Grows



Recent extensions of the Bell System coaxial network include cables between New York and Washington and between Atlanta and Jacksonville. Cables are under construction between Washington and Charlotte and between Atlanta and Fort Worth, and by the end of this year construction will be well along on the link from Fort Worth to Los Angeles. Experience in the operation of a coaxial television network has been gained through experimental use of these facilities. On December 1, 1945, the Army and Navy football game at Philadelphia was picked up and transmitted over coaxial cable to New York for broadcast. On February 12, the Lincoln Day ceremonies at Washington were picked up at several spots alternately, broadcast through a Washington station, and transmitted over coaxial cable to New York and there broadcast from two television stations. On April 15, television for the first time was transmitted in both directions between New York and Washington, programs being originated alternately at studios in the two cities and broadcast simultaneously at both points. On April 19, another milestone was passed when color television was sent over the coaxial cable from New York to Washington and back, and broadcast from the transmitter in New York.

JOINT ACTIVITIES

Second Electronics Conference in Chicago, Ill., October 3–5

Approximately 60 technical papers will be presented at the second annual National Electronics Conference at the Edgewater Beach Hotel, Chicago, Ill., October 3–5, 1946. Sponsors of the conference define its purpose as that of "a national forum on electronic research, development, and application."

The conference is planned to provide technical meetings for the presentation of original papers covering latest developments in electronics and applications of electronic apparatus; forums for the review and correlation of recent progress in the many branches of the field; and symposia for the interchange of ideas, methods of approach, and technique among scientists, electronic engineers, and others working in different fields of application.

Subjects for the scheduled sessions included television, antennas and wave propagation, microwave generators, mobile radio communication, infrared communication systems, high-frequency heating, recording and facsimile, nuclear physics, and medical and industrial applications. Though several sessions will run concurrently, the program has been arranged to minimize the overlapping of papers on related topics.

Among the prominent speakers at the conference will be: Doctor E. U. Condon (M '44) director of the National Bureau of Standards; Doctor Frederick L. Hovde, president of Purdue University; Doctor C. G. Suits (M '41) vice-president of the General Electric Company; and Doctor J. O. Perrine, vice-president of Bell Telephone Laboratories, Inc.

Adding interest to this year's conference will be a display of manufacturers' exhibits. The exhibits will consist of educational approaches to various electronic subjects and demonstrate recently developed electronic equipment. The exhibitors are manufacturer of electronic equipment in communications, power, television, instrumentation, industrial processes and controls, and transportation. Other displays will present recent applications of electronics in medicine and related fields.

Those planning to attend the conference are asked to make advance registration by mail prior to September 19. No registration can be accepted after that date. Advance remittance of $14 will cover all conference activities, including a copy of the "Proceedings," and should be sent to E. H. Schulz, secretary, Technology Center, Chicago 16, Ill. No advance registration will be considered without remittance.

The National Electronics Conference is sponsored by the Illinois Institute of Technology, Northwestern University, and the University of Illinois together with the Chicago Sections of the Institute of Radio Engineers and the AIEE. Doctor J. E. Hobson (M '41) Armour Research Foundation, is chairman of the board of directors of the conference, and W. O. Swinyard, Hazeltine Electronics Corporation, is the president. W. M. Ballenger (M '38) of the General Electric Company; R. J. Donaldson (M '44) of Northwestern University; and E. O. Neubauer (M '44) of the Illinois Bell Telephone Company are representing the AIEE Chicago Section on the executive committee. Other officers and directors are:

Doctor R. E. Beam (A '42) Northwestern University; Doctor A. B. Bronwell (M '44) Northwestern University; A. Crossley, consulting engineer; Doctor C. A. Crowley, Graham, Crowley and Associates; C. A. Emery, Westinghouse Electric Corporation; Professor G. H. Fett, University of Illinois; R. H. Herrick, Lorain Telephone Company and Lorain Radio Company; Cullen Moore, Galvin Manufacturing Corporation; Doctor L. T. Rader (M '43) Illinois Institute of Technology; Doctor C. S. Roys (M '45) Illinois Institute of Technology; Professor E. H. Schulz (M '43) Illinois Institute of Technology; O. Westerberg, Commonwealth Edison Company.

Engineering Council for New York. Organization of the Engineering Societies Council of New York, comprising delegates from the local chapters of engineering, scientific, and technical societies, recently was completed. The council is intended to enable the engineering profession to produce a better co-ordinated program in Greater New York in the public interest as well as that of the members of the participating organizations. It is the direct outgrowth of the Engineering Societies Committee on War Production, through whose efforts a number of successful clinics on technical problems were held during the war. Names of the officers chosen and the societies they represent follow:

Chairman—H. C. R. Carlson, American Society of Mechanical Engineers.

Vice-Chairman—H. P. Wall, American Society of Safety Engineers.

Secretary—M. P. Davis, American Society for Testing Materials

Treasurer—H. F. Dart (M '26) Institute of Radio Engineers.

Directors—O. B. J. Fraser, American Institute of Mining and Metallurgical Engineers; E. J. Lyons, American Institute of Chemical Engineers; W. F. O'Connor, American Chemical Society; C. S. Purnell (M '35) American Institute of Electrical Engineers; H. J. Ryan, American Society of Heating and Ventilating Engineers; and E. M. Sherwood, American Society for Metals.

AIEE delegates to the council are W. J. Barrett (M '36) and C. S. Purnell. M. D. Hooven (F '44) and J. L. Callahan (M '35) are alternates.

ASA Revises Standards List. A revised list of Standards approved to date has been published by the American Standards Association. The 845 Standards listed in the booklet include definitions of technical terms, specifications for metals and other materials, dimensions, safety provisions for the use of machinery, methods of work, and methods of test for the finished product. The list will be sent free of charge to anyone interested. Requests should be addressed to the American Standards Association, 70 East 45th Street, New York 17, N. Y.

OTHER SOCIETIES •

Russia Is 18th Country to Join UN Standards Committee

The All-Union Committee on Standards of the Union of Soviet Socialist Republics has applied for and received membership in the United Nations Standards Co-ordinating Committee, it was announced recently.

With the inclusion of the Soviet national standards body, the membership of the UNSCC now includes the following countries:

Australia
Belgium
Brazil
Canada
Chile
China
Czechoslovakia
Denmark
France
Great Britain
Mexico
Netherlands
New Zealand
Norway
Poland
South Africa
Union of Soviet Socialist Republics
United States

The UNSCC, which grew out of a conference of the national standards bodies of the United States, Canada, and Great Britain toward the end of the war, has expanded to include the national standards bodies of the other United Nations as they applied for membership. A draft constitution for a permanent international standards organization drawn up by UNSCC is being examined by the member bodies.

Pending the adoption of the constitution, standardization projects are being studied by the committee. A proposal for an international standardization program for textiles recently was submitted to the committee by the American Standards Association, American representative on the UNSCC. Other projects in process of study are: metal food containers; moisture regain of wool; definition of the term rayon; terms and definitions relating to the heat treatment of steel; plastics terminology; radio interference suppression; airfield lighting, identification, colors, and marks; filling ratios and valve outlets for gas cylinders; standards simplification of shellac grades and methods of testing the properties of shellac; standards for sheet and wire gauges; standard voltages above 220 kv; machine tools; unification of boiler construction codes; automobile standards; building standards; and documentation.

Successful Meeting Held in Buffalo by ASTM

An attendance of 1,825, second only to 1944 as an annual meeting record, was reported from the meeting of the American Society for Testing Materials held in Buffalo, N. Y., in June.

Eight symposiums, with from 4 to 15 technical papers presented at each, were held. Topics discussed included: bearings, gas turbine materials, fatigue, spectroscopic light sources, oil procurement practices, testing parts and assemblies, pH measurements, atmospheric weathering of corrosion-resistant steels, and freezing and thawing tests of concrete. Among the 25 technical sessions some were devoted to effect of temperature on metals, cement and concrete, plastics, nonferrous metals, and bituminous materials.

The 19th award of the Charles B. Dudley Medal was made to H. R. Copson, research chemist, International Nickel Company, Inc. The Edgar Marburg Lecture was delivered by Doctor J. J. Mattiello, technical director, Hilo Varnish Corporation. Among the speakers at the annual dinner were J. R. Townsend, president of ASTM and Doctor B. K. Sandwell, editor of the Canadian magazine, *Saturday Night*.

Chinese Typewriting Machine. An electroautomatic Chinese typewriter, which can be used either as an office machine or as telecommunication equipment, was demonstrated for the first time at the recent annual convention of the American section of the Chinese Institute of Engineers in New York, N. Y. The machine, designed by International Business Machines Corporation, Poughkeepsie, N. Y., makes it possible for an experienced operator to type at the rate of 40 to 45 Chinese words a minute. Some 5,400 ideographic type faces are engraved upon a cylinder in the typewriter in vertical and horizontal rows. The machine is operated with a keyboard of 43 keys. The 36 numerical keys are divided into four groups and any character can be placed in the printing position by striking one key in each group, the first determining the thousands digit, the second the hundreds digit, the third the tens digit, and the fourth determining the unit digit and operating the typing mechanism. The characters are arranged on the drum in three groups, according to the frequency with which they are used.

The first group, comprising 1,000 characters, represents 90 per cent of the ideographs used in ordinary Chinese correspondence.

Edison Foundation Organized. Announcement has been made of the incorporation of the Thomas Alva Edison Foundation "for the advancement of education and scientific research." Officers of the foundation are:

President—C. F. Kettering (F '14) vice-president in charge of engineering, General Motors Corporation.

Vice-Presidents—T. J. Watson, president, International Business Machines Corporation; K. T. Compton (F '31) president, Massachusetts Institute of Technology; R. C. Clothier, president, Rutgers University; Gano Dunn (HM '45) president, J. G. White Engineering Corporation; F. F. Tait (F '12) chairman, Dayton Power and Light Company.

Treasurer—W. W. Freeman, president, Edison Pioneers.

Secretary—John Edison Sloane, grandson of the inventer.

Mrs. Thomas Alva Edison, widow of the inventer, was elected honorary chairman; his daughter, Mrs. John Eyre Sloane, was elected honorary vice-chairman, and his son, former Governor Charles Edison, honorary president.

Chemists Elect Officers. The American Institute of Chemists recently elected the following officers to serve for the coming year:

President—Doctor Foster D. Snell, president of Foster D. Snell, Inc., Brooklyn, N. Y.

Vice-President—Doctor Joseph Mattiello, technical director, Hilo Varnish Company.

Secretary—Doctor Lloyd Van Doren, patent attorney, New York, N. Y.

Treasurer—Frederick A. Hessel, president, Montclair (N. J.) Research Corporation.

New councilors elected for three years were:

Doctor Donald B. Keyes, vice-president, Heyden Chemical Corporation; Doctor Raymond E. Kirk, dean of the graduate school and head of the department of chemistry, Polytechnic Institute of Brooklyn (N. Y.); and Doctor Donald Price.

ASTM Elects Officers for 1946–47. Announcement of the election of officers for 1946–47 was made at the 49th annual meeting of the American Society for Testing Materials in Buffalo, N. Y., in June. The officers for the coming year will be:

President—Arthur W. Carpenter, manager of testing laboratories, B. F. Goodrich Company, Akron, Ohio.

Vice-President—Richard L. Templin, assistant director of research and chief engineer of tests, Aluminum Company of America, New Kensington, Pa.

Directors—A. G. Ashcroft, director of research, Alexander Smith and Sons Carpet Company, Yonkers, N. Y.; A. T. Chameroy, manager of laboratory, Sears, Roebuck and Company, Chicago, Ill.; J. H. Foote (F '32) supervising engineer, Commonwealth and Southern Corporation, Jackson, Mich.; F. E. Richart, research professor of engineering materials, University of Illinois, Urbana, Ill.; and L. H. Winkler, metallurgical engineer, Bethlehem Steel Company, Inc.

Future Meetings of Other Societies

American Chemical Society. National Chemical Exposition, September 10–14, 1946, Chicago, Ill.

American Society of Mechanical Engineers. Fall meeting, September 30–October 2, 1946, Boston, Mass.

American Welding Society. Annual meeting, November 17–22, 1946, Atlantic City, N. J.

Electrochemical Society. Fall meeting, October 16–19, 1946, Toronto, Ontario, Canada.

Illuminating Engineering Society. National convention, September 18–21, 1946, Quebec, Quebec, Canada.

Instrument Society of America. Exhibit and conference, September 16–20, 1946, Pittsburgh, Pa.

Iron and Steel Exposition. October 1–4, 1946, Cleveland, Ohio.

National Electrical Contractors Association. Annual meeting, October 14–18, 1946, Atlantic City, N. J.

National Electrical Manufacturers Association. Annual meeting, October 28–November 1, 1946, Atlantic City, N. J.

National Electronics Conference. October 3–5, 1946, Chicago, Ill.

National Exposition of Power and Mechanical Engineering. December 2–7, 1946, New York, N. Y.

Refrigeration Equipment Manufacturers Association. Fourth refrigeration and air conditioning exposition, October 29–November 1, 1946, Cleveland, Ohio.

Television Broadcasters Association, Inc. Second conference and exhibition, October 10–11, 1946, New York, N. Y.

World Conference on Minerals. A three-day world conference on mineral resources originally scheduled to be held in New York, N. Y., September 16–18, in connection with the observance of the 75th anniversary of the American Institute of Mining and Metallurgical Engineers, has been postponed to the week of March 17, 1947. Increased requirements for hotel accommodations for the United Nations made the change in dates necessary. The conference will cover all phases of the present world situation with respect to iron and steel, coal, petroleum, nonferrous metals, and other important industrial minerals. Delegates from every mineral producing country have been invited, and the State Department is disseminating information about the conference through its representatives. Herbert Hoover (HM '29) will be conference chairman, and among those who have accepted invitations are J. A. Krug, Secretary of the Interior; Sir William Fraser, chairman of the Anglo-Iranian Oil Company; Charles M. White, president of Republic Steel Company; and Cornelius F. Kelly, chairman of the Anaconda Copper Mining Company.

Registration by Endorsement. For the benefit of engineers wishing to take advantage of the method of registration by endorsement offered by the National Bureau of Engineering Registration, the address of the bureau is: P. O. Drawer 1404, Carolina Life Building, Columbia, S. C. The work of the bureau was described in the June issue of *Electrical Engineering*, page 294.

SPEE Has New Name. On July 1, 1946, the Society for the Promotion of Engineering Education became the American Society for Engineering Education, according to an announcement received from F. L. Bishop, secretary to the society.

HONORS • • • • • •

Willard Dow Receives Chemical Medal. The Chemical Industry Medal for 1946 has been awarded to Doctor Willard H. Dow, president and chairman of the Dow Chemical Company, Midland, Mich., for "his conspicious service to applied industry." Doctor Dow also is president of the Ethyl-Dow Chemical Company which extracts bromine from sea water. Under his direction the Dow Company carried out more than 50 wartime projects for the Government. He served on the Chemical Advisory Committee of the Army and Navy Munitions Board and on the Chemical Warfare Service Advisory Board. Doctor Dow commenced his career with the company which his father founded in 1919, the year of his graduation from the University of Michigan. He took over the duties of president and general manager in 1930 and chairman of the board in 1941. Doctor Dow was the recipient of the Chandler Medal of Columbia University in 1943 and of the Gold Medal Award of the American Institute of Chemists in 1944. He holds honorary degrees from Michigan College of Mining and Technology, the University of Michigan, and the Illinois Institute of Technology.

EDUCATION • • •

W. E. Wickenden Announces His Retirement in 1947

At a dinner of the faculty of the Case School of Applied Science, Cleveland, Ohio, on June 16, President William E. Wickenden (F '39) announced his intention to retire from his duties August 31, 1947. Doctor Wickenden became third president of the Case School in September 1929.

In making his announcement, Doctor Wickenden stated: "It is my firm belief that a college president should be a relatively young man who will instinctively look to the future rather than the past and plan with discernment for the needs of an oncoming generation. A new president can benefit greatly by the opportunity to begin his work with the rise of a new economic cycle rather than near its end. Case now has completed a great war chapter in its history. It has renewed its internal organization and has launched an expanding postwar program. It is also in a sound financial condition. A new president should find here an outstanding opportunity to do creative work and a propitious time to begin."

Commenting on Doctor Wickenden's resignation, Charles C. Bradford, president of the Case Alumni Association, declared that "Every alumnus of Case will regret the resignation of Doctor Wickenden. Under his dynamic leadership, the college has advanced to a position of national prominence in the fields of pure and applied science. With supreme vision, he has laid the foundation for a greater Case in the future.

"Few people realize the many contributions in research and in technical developments that were made to the war effort by Case under Doctor Wickenden's direction. Case will miss its genial president and great leader. He will take with him the sincere appreciation and best wishes of all Case alumni."

Frank A. Quail, president of the board of trustees, stated that Doctor Wickenden's request had been granted with much reluctance and that a committee has been appointed to seek a successor.

Rensselaer Appoints Doctor Crew. William H. Crew, former chairman of the physics department of New York University and wartime assistant director of the United States Office of Scientific Research and Development, Washington, D. C., has been made assistant dean of students at Rensselaer Polytechnic Institute. Professor Crew, who was graduated from the United States Naval Academy in 1922 and who received the doctor of philosophy degree from Johns Hopkins University in 1926, joined the faculty of New York University in 1929. He had been on leave of absence since 1941.

RESEARCH • • • • •

Nuclear Physics Studies Resumed by Westinghouse

Commencement of a program of research in nuclear physics, which is a continuation of the fundamental studies that were abandoned by private companies during the war, has been announced by the Westinghouse Research Laboratories. Doctor W. E. Shoupp, manager of the electronics department, will be in charge of the program. Doctor Shoupp is the co-discoverer of photofission—the splitting of uranium atoms by high-energy gamma rays.

Modernization of the 65-foot-high atom smasher is already in progress, Doctor Shoupp disclosed. Chief among the improvements, designed to make operation easier and more automatic, will be the installation of high speed oil diffusion pumps to exhaust the air from the 35-foot vacuum tube. The pumps, using heated oil mists to drive away air molecules, leave less than one of each billion air molecules in a tank.

Before the war the Westinghouse atom smasher was capable of building up a potential of 4,000,000 volts to hurl electrified particles against a target at speeds between 30,000,000 and 100,000,000 miles an hour.

Corrosion Study at MIT. A new program of instruction and research on corrosion of metals, cause of one of the world's greatest economic losses, has been instituted at Massachusetts Institute of Technology with the appointment of Doctor Herbert H. Uhlig as associate professor in the department of metallurgy to take charge of the project. Hitherto different aspects of the problem have been investigated separately by several departments. Now the resources of all departments concerned will be co-ordinated into a single program. Doctor Uhlig plans a fundamental research program with the study of the nature of metals and metal surfaces as its main objective. The problem will be attacked from an electrochemical viewpoint and is expected to lead to a more logical approach to the selection of corrosion resistant metals and to methods of protection. Doctor Uhlig previously was associated with Rockefeller Institute, Lever Brothers, and the General Electric Company. He is editor-in-chief of the "Corrosion Handbook."

INDUSTRY • • • • •

Trucking Company Installs Radiotelephones

Completion of a two-way radio system for its fleet of more than 1,000 vehicles has been announced by the Willett Company, Chicago, Ill., and by the Raytheon Manufacturing Company which performed the installation.

The two-way radiotelephone system permits a centrally located dispatcher to communicate with any truck in the normal operating area of the company. By radiotelephone, the dispatcher can advise a truck driver immediately of cancellation of a delivery or a new order for a pickup and in deliveries of valuable cargo, the radiotelephone is a deterrent to burglary. The radiotelephone system can be equipped to operate from a concealed foot switch, so that the transmitter is placed on the air. Burglar alarms on the trucks also can be made to actuate the transmitter automatically. Radio-equipped trucks are of civic value as well, as they can immediately report fire, accident, or other emergencies encountered on their routes.

The Willett system operates on 156 to 162 megacycles.

Air-Borne Device Explores for Oil. An air-borne magnetometer, which during the war was used in hunting submarines, now promises to be the fastest means of mapping the underground structure of the most inaccessible ocean, jungle, and mountain regions. Though it was originally developed by the Gulf Oil Corporation for geophysical prospecting, the magnetic detector was perfected in 1941, and the war immediately altered its use from an industrial tool to a weapon. Flown low in blimps and airplanes the instrument gives a continuous magnetic chart of any terrain. By inferring the position of the highly magnetized basement igneous rock, it gives information about the oil-bearing formations lying above the igneous rock. It is the only known method of magnetic mapping over areas where erratic surface influences make ground reading untrustworthy and of magnetic prospecting over water. The instrument is carried in a bomb-like casing trailed beneath the airplane to eliminate magnetic interference.

Refrigeration Industry Standardizes Nomenclature

Formation of ASA Nomenclature Committee B53, sponsored by the American Society of Refrigerating Engineers, has been announced. The committee will provide terms and definitions relating to principles, processes, and equipment in design, manufacture, use, and maintenance in the refrigeration industry. Appropriate symbols also will be provided in instances not covered by existing standards.

The work of the committee has been divided among four subcommittees, namely:

1. Definitions—*Chairman*, R. J. Thompson, sale engineer, Kinetic Chemicals Company.
2. Abbreviations—*Chairman*, Clifford Strock, editor, *Heating and Ventilating*.
3. Letter symbols—*Chairman*, Professor Carl F. Kayan, Columbia University.
4. Graphical symbols—*Chairman*, E. R. Wolfert, Westinghouse Electric Corporation.

Sterling Smith, of the Baker Ice Machine Company, Omaha, Nebr., has been named chairman and M. M. Lawlor of the Worthington Pump and Machinery Company Harrison, N. J., vice-chairman of the committee.

Course on Electric Instruments Prepared by Westinghouse

Designed to give concisely a fundamental knowledge of the construction, operation, and selection of electric measuring instruments, an intensive course including sound slide films, a complete pocket size textbook, and an instructor's manual has been prepared by the Westinghouse Electric Corporation.

Primarily for use by the Westinghouse organization, the course also has been made available to educational institutions, engineering societies, and the engineering departments of all organizations that use electric measuring instruments. Cost of a complete course, based on a class of 20 members is $45. Distribution will be handled by the industrial relations department, Westinghouse Electric Corporation, 306 Fourth Avenue, Pittsburgh 30, Pa.

Subjects covered in films and lessons are: importance of electrical instruments, the permanent magnet moving coil mechanism, the electrodynamometer mechanism, the stationary coil and moving iron mechanism, the rotating vane mechanism, and the selection and use of electric instruments. It is recommended that the course be given in six one-hour sessions, with each session covering one lesson. An instructor's manual is provided.

Flying Laboratory Equipped by Honeywell. A converted C-47 airplane equipped with electronic instruments designed to measure and record more than 1,000 different functions of flight now is serving as an aeronautical laboratory for the Minneapolis-Honeywell Regulator Company. The airplane contains more than 20 miles of special electric wiring for connecting the electric system to measuring devices which record reactions to the 31 or more automatic control systems now under test. The airplane has a power supply capable of developing more than eight times the electric power of conventional DC-3 airplanes, and the craft is the first to be equipped with a radiant heating system, the latter requiring double walls and windows and a gasoline heater.

Improved Film Aids Television. A new motion picture film which will aid the telecasting of public events within a few hours or even minutes of their occurrence and give improved television images was demonstrated recently by E. I. du Pont de Nemours and Company, Wilmington, Del., manufacturers of the film, and the National Broadcasting Company, New York, N. Y. Newsreel pictures of a parade of the 442d Infantry combat team in Washington, D. C., were flown to New York immediately after the event for televising over station WNBT. To save processing time the new film was used in negative form with a minimum of editing. Use of the negative is possible since the picture is reversed as it passes through each stage of signal amplification in the television system. Therefore, only an odd number of amplification stages is needed to secure a positive representation on the receiving tube.

New Corrosion Protection. A method of protecting the galvanized coating on iron water tanks from too rapid wear and the tank from imperfections in the coating has been developed in connection with the manufacture of the Clark Water Heater by the McGraw Electric Company, Chicago, Ill. By the Clark method, a bar of magnesium is inserted in the center of the tank. Since magnesium is even more active electrically with regard to iron than the zinc coating of the tank, this bar gives protection so long as any magnesium remains. Because the current between the magnesium and the iron is much higher than is needed for protection, a resistance is inserted between the iron and the magnesium and the current consequently lowered to a point where protection is entirely adequate. At the same time the loss of the magnesium is controlled or metered to enable it to last for many years.

Pneumatic Testing Machine. A pneumatically operated fatigue testing machine, which has produced stresses as high as 100,000 pounds per square inch, with no more air being used than that supplied by the average vacuum cleaner, was described at the recent annual meeting of the American Society for Testing Materials in Buffalo, N. Y. Air from two tubes, which may be tuned to any vibrating frequency by varying the length of the air column, strike the sample piece setting it to vibrating. When the air in the tube is adjusted to the same frequency as the test sample, very large and stable amplitudes of vibrations are produced with comparatively small amounts of air. The sample vibrates until it fatigues to the extent that its vibrations are out of phase with those of the tuned air and a break occurs. Current research with the machine indicates that by use of a recording frequency meter, the point of incipient failure may be determined. Brittle materials have shown this point to be very close to that of complete fracture, but in ductile materials it appears long before visible fracture becomes apparent.

Industry Committee Elects Stevenson. H. R. Stevenson of the Detroit Edison Company recently was elected chairman of the Industry Committee on Interior Wiring Design. Mr. Stevenson also was named chairman of the technical subcommittee which soon will commence work on revising the wiring standards for commercial, public, and industrial occupancies. It also was reported at the election meeting that since its release in February, the "Handbook of Residential Wiring Design" (*EE, Feb '46, p 93*) has elicited a response of 185,000 orders. The "Handbook of Farmstead Wiring Design" (*EE, Feb '46, p 93*) is now ready for distribution, and orders for 50,000 copies have been received. A. Carl Bredahl (M '44) of the Westinghouse Electric Corporation, former chairman of the technical subcommittee, was re-elected secretary of the committee.

LETTERS TO THE EDITOR

INSTITUTE members and subscribers are invited to contribute to these columns expressions of opinion dealing with published articles, technical papers, or other subjects of general professional interest. While endeavoring to publish as many letters as possible, Electrical Engineering reserves the right to publish them in whole or in part or to reject them entirely. Statements in letters are expressly understood to be made by the writers. Publication here in no wise constitutes endorsement or recognition by the AIEE. All letters submitted for publication should be typewritten, double-spaced, not carbon copies. Any illustrations should be submitted in duplicate, one copy an inked drawing without lettering, the other lettered. Captions should be supplied for all illustrations.

Australian Member Views England, U. S., and Canada

To the Editor:

I am writing this letter to give a few high lights of my recent trip to England, the United States, and Canada, and some impressions I obtained during the trip, and something of the conditions I have found upon my return to Australia.

My trip started when I left Sydney July 16, 1945, and took six weeks via Panama to England on a troop ship, V-J Day occurring just after we entered the Atlantic Ocean. My first two impressions of England were the cheerfulness of the people considering the ordeal through which they had passed, and secondly, the apparent better health of the children in the poorer districts, due undoubtedly to the very equitable rationing scheme and methods of seeing that the children received whatever good food there was available. During almost 12 weeks I was in England I traveled some 4,000 miles, visited some 50 concerns, including several in Scotland, and left with a greater appreciation than ever of the people.

Another impression I gained was that the people were much more friendly and more keen to help a stranger than they were on my last visit, which undoubtedly was due to the many experiences everyone had had during the war.

In the United States of America and Canada I traveled something over 8,000 miles by rail and visited approximately 60 concerns. I had the expected trouble with hotel accommodation, and a number of rather uncomfortable rail trips, as I was not able always to book the seats too far ahead.

As to my impressions of the United States and Canada, in which I once lived for three years, I found that there are a number of changes, many of which are a direct consequence of the war and are quite abnormal. The population is mixing more than it used to, and I found it much more difficult to determine from the speech of the people what part of the country they hailed from. It appears to me to be all to the good that North and South and East and West should mingle more. Again, in the United States and Toronto, Canada, I cannot speak too highly of the way I was received and treated, and I do not take this all as a compliment to my position or personality, but rather to the very favorable and wonderful publicity for Australia and Australians which has been given by servicemen who spent time in Australia and have returned to America.

To all my overseas friends I would say that, while we in Australia are essentially British in sympathies, and Britain being our best customer must receive preference where comparable goods are available, nevertheless, so far as conditions in Australia are concerned—the mode of living, the distances to travel, and the variations of climate from North to South—they are much more comparable with those of the United States. In consequence, some United States products, such as motor cars, are more suitable for our purposes than are English ones.

As to conditions in Australia, I am able to confirm that the statement I made in England that the cost of living in Australia was lower and that the English wages were higher, is correct; also my statement in United States that the Australian cost of living is about one third and wages one third those in the United States is correct.

Making a quick and brief survey around the shops of Melbourne on the day of my arrival I was able to confirm that various foods and most essentials are one third the price of those in America under present exchange conditions. The only instance where prices are at all comparable, or may even be higher, is in certain luxury lines which are imported, and such items as motor cars and oil fuel which also are imported. As to what will happen concerning the exchange situation, I cannot see how it will be possible to allow it to continue at the present rate for very long. Even so, we will still have a very great advantage in the cost of living and general over-all production costs. For this reason I believe that Australia has a very great future, particularly if it is possible to obtain any real stability in the industrial field. While it is recognized that our industrial arbitration system has in it room for much improvement, I am satisfied that it is better than anything so far evolved in the United States, Canada, or England.

On the domestic side I find that some clothing is rather short, but owing to our rationing we all will get our share. Some items of food are still not available, even though they are produced in large quantities and normally exported. For example, prunes and rice and arrowroot, which comes from the adjacent Pacific Islands, are also nonprocurable. Meat, butter, sugar, and tea still are rationed. The butter ration is six ounces per week (my United States friends, we do get the six ounces too), tea is two ounces per person per week, while sugar has been increased to two pounds per person per week. Meat is on a basis of value which would be very difficult to give here, but all I can say is that it is three or four times as much as the English ration, but of course that is still a fraction of our prewar meat diet, Australia having been one of the largest meat-eating countries in the world. Though some items of clothing are scarce, knitted wear and several other items have been taken off the rationing list; and, though cotton quality is not very high, nevertheless, there appears to be clothing enough to go around. Altogether I think the Rationing and Price Fixing Departments have done a really good job, even though sometimes we do find the restrictions annoying.

In case this letter should appear too much of a eulogy, perhaps I should include some small criticism.

We here in Australia have suffered criticism from globe-trotting people for many generations, much of it undoubtedly, justifiable, but we do object to the person who spends six weeks or little more in our 3,000,000 square mile country and goes away and writes a book about it. One of the earliest offenders and one of the worst was Foster Frazer. He wrote such rubbish as: "Australia's Songless Birds and Scentless Flowers" and "It is possible to drive a horse in a four-wheeled buggy through any part of the Australian forest."

To my friends in Great Britain I would say that I don't like milk in my tea, and have not spoiled either of the two good beverages by mixing them for at least 25 years. I can say safely that at least 30 per cent of the men of Australia do not mix these two drinks, whatever others they may mix; and secondly the one thing I missed in Britain more than anything was my morning shower, and on the one occasion when I tried a cold plunge bath, I am afraid I was not popular with the hotel maids.

To my American and Canadian friends, please understand that we of the three British Dominions below the Equator are as British as any Englishman, nevertheless, like Scotsmen, do not like to be called English. In other words, I would remind you that there are a good many millions of people who speak the English language unlike the way it is spoken on the American Continent, who are not necessarily English.

I found it a great inconvenience and sometimes a loss of time in contacting many concerns in the United States that the peculiar custom has grown up of omitting to include the telephone number on business letterheads, and sometimes on personal visiting cards. I failed to find any good reason for this practice, and when choice of hotels does not exist, telephone books can be scarce, particularly intercity telephone books.

Finally, I would say that I returned to Australia with increasing confidence for its future and a further conviction that the two requisites to its progress are more people and more capital. I hope to see many from the crowded parts of England and Europe and many of the adventurous souls from the United States also coming here. As to a place for investment, I don't say this is typical, but I noticed the other day that on the ordinary shares of the Goodyear Tire and Rubber Company (Australia), Ltd., which are owned by America, the dividend for last year was 22 per cent.

R. ALAN CROOK (M '44)

(Managing director, Alan Crook Electrical Company, Proprietary, Ltd., St. Leonards, New South Wales, Australia)

Electrical Problem

To the Editor:

In my work I have come across the following problem which lends itself to a rather tricky solution. Though the mathematical solution becomes quite involved, the diagrammatical solution is fairly simple.

When the switch in Figure 1 is opened, determine:

1. The value of R_2 to give maximum rise in line current.
2. The rise in line current.

The solution follows.

In the circuit $I_1+I_2=I_{\text{line}}$, or on the vector diagram $\mathbf{AB}+\mathbf{BD}=\mathbf{AD}$.

Point D follows the locus of a circle diagram, so that to I_1 is added semicircle BDE drawn on diameter

$$BE=\frac{E}{X_c}$$

at right angle to AB.

From point A through the center, c, of the semicircle a line is drawn, ACD. If at point D, on the circumference a tangent MM to the semicircle is drawn and a circle, NN, with center at A and radius AD drawn, it is seen from the geometry of the figure line ACD will be the maximum current.

On the figure $AB=E/R_1$ and $CB=E/2X_c$. Therefore,

$$AC=E\sqrt{\frac{1}{R_1^2}+\frac{1}{4X_c^2}}=\frac{E}{2R_1X_c}\sqrt{R_1^2+4X_c^2}$$

Therefore,

$$\text{Maximum } I_{\text{line}}=\frac{E}{2X_c}+\frac{E}{2R_1X_c}\sqrt{R_1^2+4X_c^2}$$

$$=\frac{E}{2X_c}\left[1+\frac{\sqrt{R_1^2+4X_c^2}}{R_1}\right]$$

$$\theta=\tan^{-1}\frac{E/2X_c}{E/R_1}=\tan^{-1}\frac{R_1}{2X_c}$$

$$I_2=I_{2x}+jI_{2y}$$

or geometrically

$$\begin{aligned}\mathbf{BD}&=BG+jGD\\&=CF+j[BC+FD]\end{aligned}$$

Then

$$I_{2x}=\frac{E}{2X_c}\cos\theta$$

and

$$I_{2y}=\frac{E}{2X_c}+\frac{E}{2X_c}\sin\theta=\frac{E}{2X_c}[1+\sin\theta]$$

yielding

$$R_2=\frac{E}{I_2}\,\frac{I_{2x}}{I_2}$$

With switch closed

$$I_{\text{line}}=\sqrt{\left(\frac{E}{R_1}\right)^2+(E/X_c)^2}$$

$$=\frac{E}{R_1X_c}\sqrt{R_1^2+X_c^2}$$

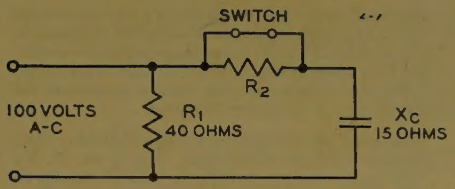


Figure 1. The problem

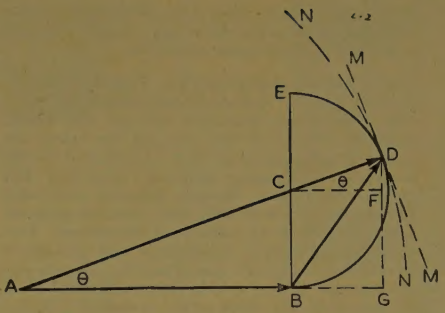


Figure 2. The solution

Using the circuit values:

$E=100$ volts
$R_1=40$ ohms
$X_c=15$ ohms

$$\text{Maximum } I_{\text{line}}=\frac{100}{30}\left[1+\frac{\sqrt{40^2+4(15)^2}}{40}\right]$$
$$=7.5 \text{ amperes}$$

$$\theta=\tan^{-1}\frac{40}{30}$$

therefore $\cos\theta=\frac{3}{5}$ and $\sin\theta=\frac{4}{5}$

$$I_{2x}=\frac{100}{30}\,\frac{3}{5}=2 \text{ amperes}$$

$$I_{2y}=\frac{100}{30}\left[1+\frac{4}{5}\right]=6 \text{ amperes}$$

$$I_2=\sqrt{2^2+6^2}=\sqrt{38}$$

$$R_2=\frac{100}{\sqrt{38}}\,\frac{2}{\sqrt{38}}=\frac{100}{19}=5.24 \text{ ohms}$$

With switch closed

$$I_{\text{line}}=\frac{100}{15\times 40}\sqrt{15^2+40^2}=7.12 \text{ amperes}$$

Then the rise is 0.38 ampere.

E. NORMAN LURCH (A '45)

(Department of electrical engineering, Manhattan College, New York, N. Y.)

NEW BOOKS . . .

The following new books are among those recently received at the Engineering Societies Library. Unless otherwise specified, books listed have been presented by the publishers. The Institute assumes no responsibilty for statements made in the following summaries, information for which is taken from the prefaces of the books in question.

PRODUITS RÉSINEUX. By R. Lombard. Preface by J. Duclaux. Dunod, Paris, France, 1946. 315 pages, illustrated, 9 by $5^{1}/_{2}$ inches, paper, 385 francs. A general study of resinous materials of vegetable origin is presented with a thorough treatment of the chemistry of their constituents. Considerable space is devoted to colophony, the common pine resin remaining after turpentine distillation. Its chemistry and applications are covered, and a bibliography on its comparison with other natural resins is included. A brief chapter on methods of analysis of resinous products concludes the book.

PRODUCTION ILLUSTRATION, the Techniques and Applications of Perspective Engineering Drawings. By J. Treacy. John Wiley and Sons, New York, N. Y.; Chapman and Hall, London, England, 1945. 202 pages, illustrations, diagrams, charts, tables, $9^{1}/_{4}$ by $11^{1}/_{2}$ inches, cloth, \$4. This book presents the forms and processes of production illustration in simple form including the actual preparation of production illustrations as well as a discussion of why, when, and where production illustration is of use in industrial production. The book is illustrated profusely with examples of actual production drawings.

RUSSIAN-ENGLISH SCIENTIFIC-TECHNICAL DICTIONARY, compiled and edited by A. Bray. International Universities Press, 227 West 13th St., New York, N. Y., 1945. 551 pages, $9^{1}/_{2}$ by 6 inches, cloth, \$10. The scope of this dictionary is indicated by the types of words included: basic terminology of fundamental fields such as mathematics, mechanics, physics, and chemistry; words and expressions for all the main technical fields likely not to be found in a general dictionary; and terms pertaining to new fields of science and industry.

STEELWAYS OF NEW ENGLAND. By A. F. Harlow. Creative Age Press, New York, N. Y., 1946. 461 pages, illustrated, $8^{1}/_{4}$ by $5^{1}/_{4}$ inches, cloth, \$3.50. First of a projected series covering the American railroads, this book presents a detailed history of the many roads, which occupied the New England scene. Beginning with the first horse-operated line out of Quincy, Mass., in 1826, the author depicts the struggles, successes, and failures incidental to the growth of the present-day network which serves the New England States. A 13-page bibliography and a detailed index add to the value of the book.

ATOMIC ENERGY in WAR and PEACE. By G. G. Hawley and S. W. Leifson. Reinhold Publishing Corporation, New York, N. Y., 1945. 211 pages, illustrated, diagrams, tables, $7^{3}/_{4}$ by 5 inches, cloth, \$2.50. The first part of this book discusses atoms, neutrons, energy transformations, combustion, explosions, radioactivity, transmutation, nuclear fission, and other subjects of fundamental importance. The second part, based on the official report of the atomic bomb project, gives the story of this tremendous job, the obstacles to be surmounted, and the means by which it was done. A concluding section discusses future military and industrial applications of atomic energy in the light of present knowledge.

RÉSINES VINYLIQUES. By H. Gibello. Preface by J. Duclaux. Dunod, Paris, France, 1946. 222 pages, illustrated, 9 by $5^{1}/_{2}$ inches, paper, 260 francs. The theory and practice of the fabrication and polymerization of the vinyl resins are covered in the first three chapters. The chemical derivatives of the polymers are discussed. Two chapters are devoted to industrial applications of vinyl compounds, one from the viewpoint of the field of use, the other by considering the various resins individually. The qualitative and quantitative analysis of vinyl resins is treated briefly.

RUBBER IN ENGINEERING. Prepared under the direction of the Controller of Chemical Research of the British Ministry of Supply and the Directors of Scientific Research of the Ministry of Aircraft Production and the Admiralty on the Basis of Research carried out by the Imperial Chemical Industries, Ltd. Chemical Publishing Company, Brooklyn, N. Y., 1946. 267 pages, illustrated, $8^{2}/_{4}$ by $5^{1}/_{2}$ inches, cloth, \$5.50. Part I, describing the rubber-like state, and part II, discussing the general properties of rubber, furnish engineers with a general survey of the information available on the theoretical aspects of the subject. Part III provides useful information on the compatibility and incompatibility of rubber properties in their relation to practical use, covers the bonding of rubber to metal, and discusses other aspects of rubber technology. Part IV deals at some length with the principles of the design of rubber engineering components for shock absorption, vibration insulation, and the like.

MEDICINE IN INDUSTRY. By B. J. Stern. Commonwealth Fund, New York, N. Y., 1946. 209 pages, tables, $8^{1}/_{2}$ by $5^{1}/_{4}$ inches, cloth, \$1.50. The author traces broadly the social, economic, legal, and professional setting within which industrial medicine has progressed, and discusses the development of knowledge which enables industrial physicians to cope with many diseases affected by occupations. Data are presented on the rates of industrial disability and the limited extent or preventive services. Recent developments in health and insurance programs are dealt with, the problems of the handicapped in industry are considered, and the relationships between industrial physician and general practitioner are discussed.

SEQUENTIAL ANALYSIS IN INSPECTION AND EXPERIMENTATION. Revised and enlarged edition. Prepared by the statistical research group, Columbia University, for the Applied Mathematics Panel, National Defense Research Committee, Office of Scientific Research and Development. Columbia University Press, New York, N. Y., 1945. Paged in sections, illustrated, $11^{1}/_{2}$ by 10 inches, lithoprinted, loose leaf, fabrikoid binder, \$6.25. Section I of this work discusses the general theory of the method as applied to inspection and experimentation. Sections II to VI inclusive describe the practical operation of the system under varying conditions and for various purposes. Some of the properties and fundamental mathematical principles of sequential analysis are explained in the appendixes which occupy the last section. The several sections are bound in separate pamphlet form and contained in a ring binder for easier separate use.

TABLES OF FUNCTIONS WITH FORMULAE AND CURVES (Funktionentafeln mit Formeln und Kurven). By E. Jahnke und F. Emde. Fourth edition. Dover Publications, New York, N. Y., 1945. 306 pages+76 pages, illustrated, 9 by $5^{1}/_{2}$ inches, cloth, \$3.75. This collection of tables again has been reprinted, with many errors corrected and a supplementary bibliography. These changes increase the value of the book already great as the most comprehensive in its field.

TIME STUDY AND MOTION ECONOMY. By R. L. Morrow. Ronald Press Company, New York, N. Y., 1946. 338 pages, illustrated, $9^{1}/_{2}$ by 6 inches, cloth, \$5. All procedures described in this book, with the exception of the new synthetic leveling, have been used regularly in practice. The author describes ways to study operations, take observations, and compute all necessary data. Charts, tables, and diagrams are used extensively to illustrate the methods and the kinds of records discussed in the text. The book is designed for the small as well as for the large plant.

PLANNING FOR JOBS. Edited by L. Fitch and H. Taylor. Blakiston Company, Philadelphia, Pa., and Toronto, Ontario, Canada, 1946. 463 pages, tables, $8^{3}/_{4}$ by $5^{3}/_{4}$ inches, cloth, \$3.75. The plans and suggestions presented in this book were selected from several thousand submitted essays and cover a wide range of opinions and points of view. The material is grouped under several headings: measures to promote private investment, including tax reforms and the abolishing of restrictive practices; measures to promote consumption, including tax reforms and consumer subsidies; fiscal programs and momentary reforms, including public works and market programs; and measures dealing with the supply of labor and the labor market, including wage and labor union reforms and work sharing proposals. The object is to indicate the principal trends of public thinking.

NEW CAREERS IN INDUSTRY. By J. M. Amiss and E. Sherman. McGraw-Hill Book Company, Whittlesey House Division, New York, N. Y., and London, England, 1946. 227 pages, illustrated, $8^{1}/_{4}$ by $5^{1}/_{2}$ inches, cloth, \$2.50. The main types of jobs available in industry are discussed from several viewpoints. Necessarily, information is given about duties, working conditions, wages, and qualifications. Additionally, the authors emphasize the importance of the individual job, its place in the total pattern of industry, and opportunities for advancement. The field is covered from the machine operator to the salesman, from the supervisor of mechanical operations to the supervisor of personnel and labor relations. Suggestions also are given for planning for the necessary educational training and for the evaluation of one's own qualifications.

JOB EVALUATION METHODS. By C. W. Lytle. Ronald Press Company, New York, N. Y., 1946. 329 pages, illustrations, $9\frac{1}{2}$ by 6 inches, cloth, \$6. The author presents an analytic approach to the subject. The procedure of job analysis and evaluation is separated into functional steps as indicated by the chapter headings, in order to compare and select methods and characteristics to fit any given set of conditions. The application of evaluation to office and supervisory positions is considered, and there is a special chapter on merit rating.

EXECUTIVE IN ACTION. By M. E. Dimock. Harper and Brothers, New York, N. Y., and London, England, 1945. 276 pages, $8\frac{3}{4}$ by $5\frac{1}{4}$ inches, cloth, \$3. From the executive's viewpoint this book discusses the day by day activities of an executive, how he functions in a new organization, in general organization policies, in financial planning, personnel control and other phases of business. It attempts to show that there is more in common between business and government than there is of difference. The author draws on his own experience, largely in governmental positions, for examples to illustrate the practices discussed.

ELECTRIC CIRCUITS AND MACHINES. By E. C. Lister. McGraw-Hill Book Company, New York, N. Y., and London, England, 1945. 358 pages, illustrated, $8\frac{1}{2}$ by $5\frac{1}{4}$ inches, cloth, \$3.50. This text, prepared for a brief course offered in the specialized training program at Iowa State College during the years 1942–44, covers the fundamentals of electricity with which the practical man must be familiar. The treatment is as nonmathematical as is practicable.

TÉLÉTRANSMISSIONS PAR ONDES PORTEUSES. By A. Chevallier. Preface by E. Mercier. Dunod, Paris, France, 1946. 111 pages, illustrated, 10 by $6\frac{1}{2}$ inches, paper, 390 francs. This book covers the theory and practice of teletransmission by carrier waves in high voltage networks. Connections, methods of modulation, radiations from high voltage lines, transmitting and receiving equipment, wave ranges, and filters are some of the topics covered. Separate chapters are devoted to telephony, selective protection of high voltage lines, and impulse frequency telemetering.

LES VIBRATIONS SUR LES AVIONS. By M. Berthaume. Preface by M. Vernisse. Dunod, Paris, France, 1946. 79 pages, illustrated, 10 by $6\frac{1}{2}$ inches, paper, 275 francs. Beginning with a theoretical discussion of the characteristics of vibration in airplanes, this book proceeds to a practical treatment of the necessary calculations and methods of testing, with numerical examples. Information is given on methods for reducing these vibrations, with specific remedies for specified cases.

LUMINOUS TUBE LIGHTING. By H. A. Miller. Chemical Publishing Company, Brooklyn, N. Y., 1946. 143 pages, illustrated, $8\frac{3}{4}$ by $5\frac{1}{4}$ inches, cloth, \$3.50. The underlying principles of the luminous tube are explained, the materials and equipment involved in their manufacture are described, and the discharge tube light sources are discussed. Both low and high pressure tubes are considered, and a separate chapter covers neon signs. A collection of technical data is included.

ELECTRONIC EQUIPMENT. By R. C. Walker. Chemical Publishing Company, Brooklyn, N. Y., 1945. 393 pages, illustrated, $8\frac{3}{4}$ by $5\frac{1}{4}$ inches, cloth, \$6. Specific information is given on the various applications of electronic devices, with many illustrative examples outside the field of telecommunication. The book constitutes a simple introduction of the main sections of the subject of electronics to practical engineers, mechanics, and the like.

ELECTRICAL PROTECTIVE EQUIPMENT AND POWER-FACTOR CORRECTION. By E. S. Lincoln. Essential Books, New York, N. Y., 1945. 242 pages, illustrated, $8\frac{1}{4}$ by $5\frac{1}{4}$ inches, cloth, \$3. This book presents the fundamentals of electric circuit protection by means of fuses and circuit breakers against overloads, reverse currents under voltage, and overvoltage. The equipment is described in detail, including fire protection and fire fighting equipment. The material is based on the provisions of the National Electric Code and the National Electrical Manufacturers Association definitions applying to protection and protective relays. A special chapter is devoted to power factor correction.

ELECTRICAL MEASURING INSTRUMENTS. By E. S. Lincoln. Essential Books, New York, N. Y., 1945. 284 pages, illustrated, $8\frac{1}{4}$ by $5\frac{1}{4}$ inches, cloth, \$3. Part I of this practical text covers the operating principles of all types of industrial electric measuring instruments, including integrating and graphic instruments. Ranges, damping, sensitivity, and accuracy are dealt with, and tables are given for quick reference in the selection of instruments. Part II covers instrument transformers and procedures for making electrical measurements. Details are given in part III for making electrical surveys of an entire system from which proper operation of equipment and useful economies may be determined.

ELECTRIC MOTORS AND GENERATORS. By E. S. Lincoln. Essential Books, New York, N. Y., 1945. 381 pages, illustrated, $8\frac{1}{4}$ by $5\frac{1}{2}$ inches, cloth, \$3. This practical volume describes all kinds of d-c and a-c motors and generators, with instructions for installation and operation. Tables are provided showing complete standardization of motor manufacture and use. A final chapter covers a variety of related drives: belting, gears, chain drives, variable speed transmission, couplings, and clutches.

EINLEITUNG IN DIE MENGENLEHRE. By A. Fraenkel. Third revision and enlarged edition, 1946. 424 pages, illustrated, $8\frac{3}{4}$ by $5\frac{1}{2}$ inches, cloth, \$4. The first three chapters of this standard German work on the theory of aggregates cover the usual material: fundamentals and cardinal numbers; operations with cardinal numbers; order types and order numbers. The fourth chapter deals with attacks on the fundamentals and their consequences. The last chapter discusses the axiomatic structure of the theory of sets and the axiomatic method. There is a long bibliography.

DICTIONARY OF AERONAUTICS. By E. B. French. Mentzer, Bush and Company, Chicago, Ill., 1945. 129 pages, illustrated, $8\frac{1}{2}$ by $5\frac{1}{2}$ inches, cloth, 75 cents. Words and phrases in the field of aviation and aeronautical engineering are defined in a concise manner. The illustrations are designed to identify and relate a number of terms as a group. Separate glossaries are provided for aerological and navigational terms.

DESCRIPTIVE GEOMETRY. By E. F. Watts and J. T. Rule. Prentice-Hall, Inc., New York, N. Y., 1946. 301 pages, illustrated, $9\frac{1}{4}$ by 6 inches, cloth, \$3. The theory of descriptive geometry is developed fully as a basis for the solving of engineering problems by graphical methods. Separate chapters are appended, dealing with precision in drawing, properties of plane figures, and stereoscopic drawing. Problems accompany each chapter to illustrate in a practical manner the material discussed.

ANALYTICAL GEOMETRY AND CALCULUS. By H. B. Phillips. Addison-Wesley Press, Kendall Square Building, Cambridge, Mass., 1942 (1946 printing). 457 pages plus 21 pages of answers to problems and 47 pages of supplementary problems; diagrams, $9\frac{1}{4}$ by 6 inches, cloth, \$5. The object of this text is to provide a course in analytical geometry and calculus for students of science and engineering. Certain fundamental topics in analysis needed for the logical development of calculus are discussed in the first chapter. An elementary treatment of vector analysis and functions of a complex variable is included for work in mechanics and for the analysis of various physical fields.

PRACTICAL SALES MANAGEMENT. By H. Simmons. Prentice-Hall, Inc., New York, N. Y., 1946. 427 pages, illustrated, $9\frac{1}{4}$ by 6 inches, cloth, \$5. Modern sales management fundamentals, including the requirements for, and the duties of, a sales manager, are discussed in section I. Section II deals with the selecting, training, and handling of salesmen. Visual selling aids, such as sales manuals and catalogues, are described in section III. The fourth section covers modern research in markets, products, consumers, and sales analysis. Section V includes: sales meetings, selective selling, direct mail advertising, and public speaking.

SUPERVISING PEOPLE. By G. D. Halsey. Harper and Brothers, New York, N. Y., and London 1946. 233 pages, tables, $8\frac{3}{4}$ by $5\frac{1}{4}$ inches, cloth, \$3. For the use of those who are directly in charge of working groups, the author presents a simple, straightforward statement of all the phases of supervision which can be improved by systematic study and application. The material, from job rating to morale improvement, has been taken from the practical experience of the author and others and gives specific suggestions for the solution of numerous difficulties.

MODERN PLASTICS ENCYCLOPEDIA, 1946. Plastics Catalogue Corporation, New York, N. Y., 1,389 pages, illustrated, $11\frac{1}{4}$ by 8 inches, cloth, \$6 (\$7, Canada). This standard compendium of information on plastics commences with a review of recent progress. Methods of identifying and testing plastics are described, the varieties are discussed at length, and their qualities are considered from a practical viewpoint. Other sections deal with engineering design; methods of molding, extruding and casting; fabricating, finishing and assembling; machinery and equipment; laminates, plywood, and vulcanized fiber; coatings; and synthetics and rubber-like plastics.

MODERN PLASTICS. By H. Barron. John Wiley and Sons, New York, N. Y.; Chapman and Hall, London, England, 1945. 680 pages, illustrated, $8\frac{1}{2}$ by $5\frac{1}{2}$ inches, cloth, \$7.50. The introduction discusses raw materials and the polymerization process. The succeeding parts deal respectively with: thermosetting resins and their plastics; cellulose plastics; vinyl plastics; other leading plastics, including casein; some important aspects of plastics, such as the use of high-frequency heating and physical testing methods. Processes and plastics are closely associated, as: molding and phenolics; injection molding and cellulose acetate; extrusion and polyvinyl chloride; fibers and nylon.

NATURAL COLOR PROCESSES. By C. E. Dunn. Fourth edition. American Photographic Publishing Company, Boston, Mass., 1945. 232 pages, illustrated, 8 by $5\frac{1}{4}$ inches, cloth, \$3. Written for the professional and advanced photographer, this book gives detailed information for the making of photographs in color by both the subtractive or additive methods. The author not only covers thoroughly the manipulation of films and filters and the matter of exposure calculations but also gives detailed instructions on the mixing and use of all necessary chemicals—developers, fixers, and so forth. There is an introductory chapter on the theory of simple color analysis.

NATURE OF PATENTABLE INVENTION. By J. E. R. Hayes. Addison-Wesley Press, Cambridge 42, Mass., 1945. 183 pages, $9\frac{1}{4}$ by 6 inches, cloth, \$5. The author first discusses in considerable detail the concept of invention as a mental process. He then takes up the various phrases such as "new and useful result" and "addition to the sum of knowledge" by which the validity of an invention is tested and explans their interpretation. Other sections cover the analysis of ideas, tests for invention, and identification of results. The allowability and the proper expression of claims are dealt with. Throughout the book direct quotations from cases and judgments are used extensively to illustrate the points involved.

PAMPHLETS • • •

The following recently issued pamphlets may be of interest to readers of "Electrical Engineering." All inquiries should be addressed to the issuers.

As the Automobile Comes Back. Publication GED-1104. General Electric Company, Schenectady, N. Y., 27 pages.

The Solar System. New company magazine of the Solar Manufacturing Corporation, 285 Madison Avenue, New York 17, N. Y., which will be issued six times a year.

How to Use One Bank of Transformers to Supply Two Different Loads. By O. T. Farry, Wagner Electric Corporation, 6400 Plymouth Avenue, Saint Louis, Mo., 11 pages, no charge.